mercruiser

SERVICE MANUAL

Number 6

Sterndrive Units R·MR·Alpha One· Alpha One SS

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MerCruiser #6 Sterndrive Units
R MR Alpha One Alpha One SS

90-12934--2

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MerCruiser #6 Sterndrive Units
R MR Alpha One Alpha One SS

90-12934--2

Models Covered in This Manual

Transom Assemblies

Model	Serial Number
MC 120R/140B/185R/488R/898R/228R/260R	6216687 – 6849289
MC 120MR/140MR/170MR/185MR/190MR/200MR/ 230MR/260MR/300 Tempest MR	6849290 – 0A471374
MC Alpha One/Alpha One SS	0A471375 and Above

Sterndrive Units

MC 120R-260R		
Original Ratio	**Ratio If Serviced With 13:21 Gears**	**Serial Number**
1.98:1	1.94:1	6237861-6854392
1.84:1	1.81:1	6225577-6862701
1.65:1	1.62:1	6268065-6810537
1.50:1	1.47:1	6229158-6847029
1.32:1	1.29:1	6231571-6663947

MC 120 MR - 300 TEMPEST MR		
Original Ratio	**Ratio If Serviced With 13:28 Gears**	**Serial Number**
1.98:1	1.94:1	6854393-0A476746
1.84:1	1.81:1	6862702-0A470164
1.65:1	1.62:1	6810538-0A475786
1.50:1	1.47:1	6847030-0A479506

MC ALPHA ONE / ALPHA ONE SS			
Original Ratio	**Ratio If Serviced With 13:28 Gears**	**R.H. Serial Number**	**L.H. Serial Number**
1.98:1	1.98:1	0A476747 and Above	0C881740 and Above
1.84:1	1.84:1	0A470165 and Above	0C884040 and Above
1.65:1	1.65:1	0A475787 and Above	0C881790 and Above
1.50:1	1.50:1	0A479507 and Above	0C852908 and Above
1.32:1	1.32:1	0A613927 and Above	
Alpha One SS 1.50:1/1.32:1	1.50/1.32:1	0A545004 and Above	

Sea Ray Sterndrive Units and Transom Assembly (Oyster White)

Original Ratio	Ratio If Serviced With 13:21 Gears	Serial Number
1.98:1		0B803866-0C348031
1.84:1		0B800854-0C343526
1.50:1		0B796473-0C340666
1.32:1		0B804807-0C340030
Transom Assembly		0B815811-0C340333

When making repairs to Sea Ray (Oyster White) sterndrives, follow procedures as outlined for corresponding MerCruiser models as shown in the cross-reference chart below.

Sea Ray	MerCruiser
3.0L	3.0L Alpha One
4.3L2	4.3L Alpha One
4.3L4	4.3LX Alpha One
5.7L	5.7L Alpha One
SRX 5.7L	350 Magnum Alpha One
SRX 7.4L	454 Magnum Alpha One

Notice

Throughout this publication, “Warnings” and “Cautions” (accompanied by the International HAZARD symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. — OBSERVE THEM CAREFULLY! These “Safety Alerts” alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus “common sense” operation, are major accident prevention measures.

⚠ DANGER

DANGER - Immediate hazards which will result in severe personal injury or death.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

CAUTION - Hazards or unsafe practices which could result in minor personal injury or product or property damage.

IMPORTANT: Indicates information or instructions that are necessary for proper operation and/or maintenance.

Notice To Users of This Manual

This service manual has been written and published by the service department of the manufacturer to aid our dealers’ mechanics and company service personnel when servicing the product described herein. It is assumed that these personnel are familiar with the servicing procedures of this product, or like or similar products. That they have been trained in the recommended servicing procedures of these products which includes the use of mechanics’ common hand tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of all possible hazards and/or result of each method. We have not undertaken any such wise evaluation. Therefore, anyone who uses a service procedure and/or tool which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product’s safety will be endangered by the service procedure selected.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at time of publication.

As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

Replacement Parts

⚠ WARNING

Electrical system components on gasoline engines and MerCruiser Stern Drives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing electrical systems, it is extremely important that all components are properly installed and tightened. If not, any electrical component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they exist or develop.

⚠ WARNING

Electrical system components on diesel engines are not external ignition protected. DO NOT STORE OR UTILIZE GASOLINE ON BOATS EQUIPPED WITH THESE ENGINES, UNLESS PROVISIONS HAVE BEEN MADE TO EXCLUDE GASOLINE VAPORS FROM ENGINE COMPARTMENT (ref: 33 CFR). Failure to comply could result in fire, explosion and/or severe personal injury.

Service Manual Outline

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- C - Troubleshooting

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- A - Drive Shaft Housing
- B - Gear Housing - MR/Alpha One/Alpha One SS
- C - Gear Housing - I-R
- D - Gear Housing - Alpha One Counter Rotation

Section 4 - Transom Assembly
- A - Service Procedures Requiring Minor Disassembly
- B - Service Procedures Requiring Major Disassembly

Section 5 - Power Trim
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- B - Oildyne Power Trim Pump (Aluminum Reservoir)
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- E - Dual Power Trim Control
- F - Auto Trim II

Section 6 - Steering Systems
- A - Power Steering
- B - Manual Steering

Section 7 - Corrosion Protection
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GENERAL INFORMATION

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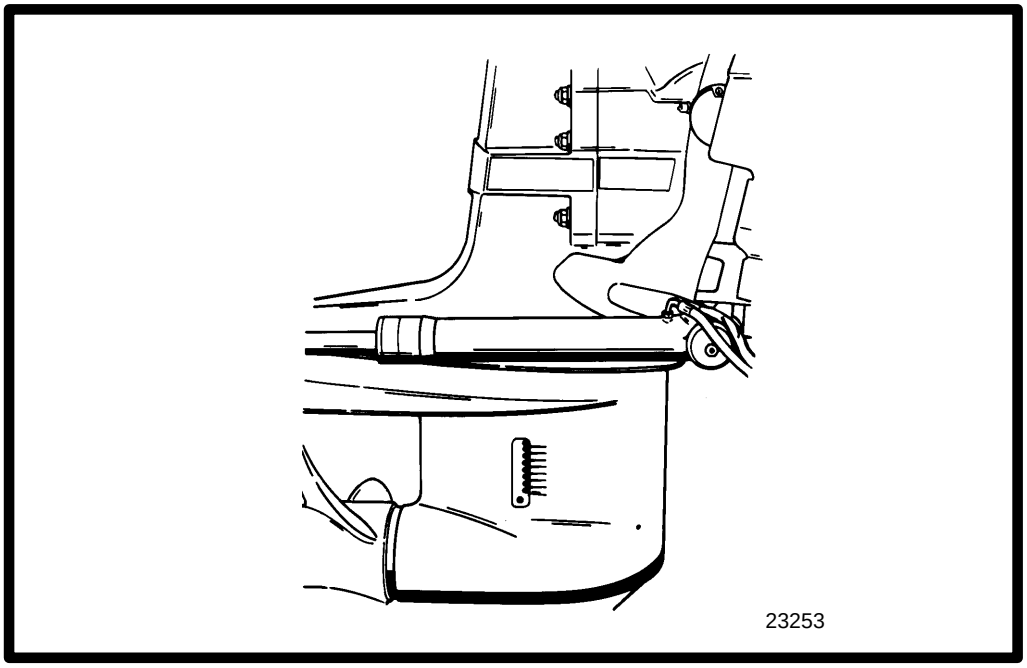

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How To Use This Manual

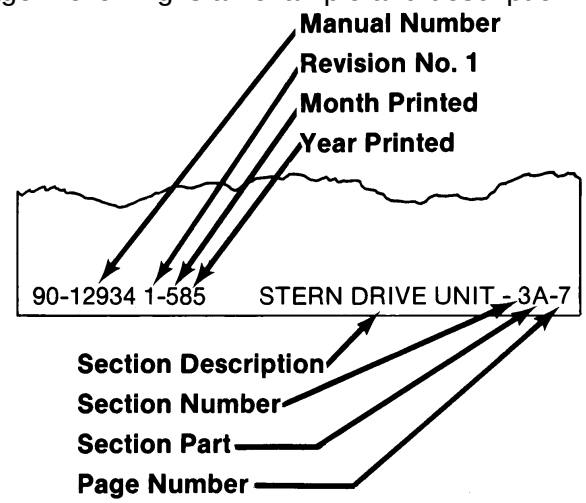
This Manual is divided into sections which represent major components and systems.

Some sections are further divided into parts which more fully describe the component.

Sections and parts are listed on page.

Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.



Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the MerCruiser models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment, to enable dealers and service mechanics to repair these products.

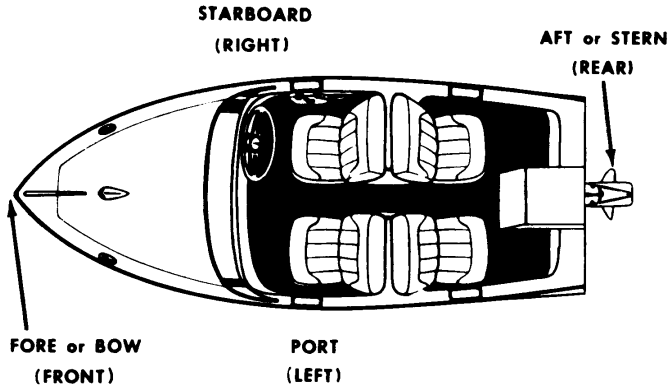
Before attempting repairs, it is suggested that procedure first be read through to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

Special Product Information

During production of these models, special product improvements and changes have been made to increase product reliability and performance. Such changes to a sterndrive assembly component(s) are covered in the “Special Information” portion of the appropriate sterndrive assembly section. (Refer to the section “Index”.) Serial number breaks are provided, where applicable, for ease of identification.

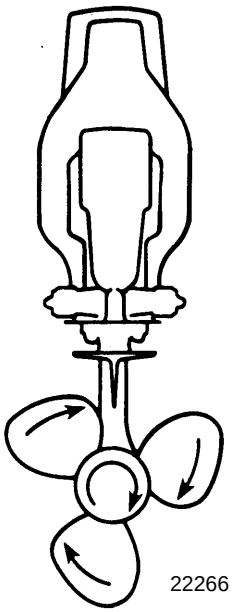
Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this service manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.

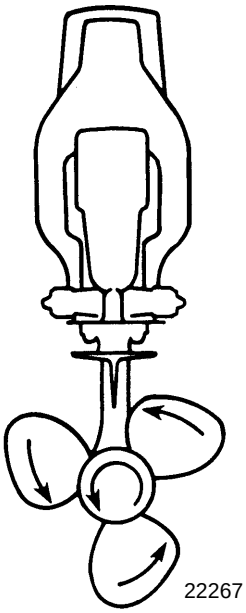


Propeller Rotation

Propeller rotation for sterndrive can be right hand or left hand rotation as viewed from the aft end of the propeller.

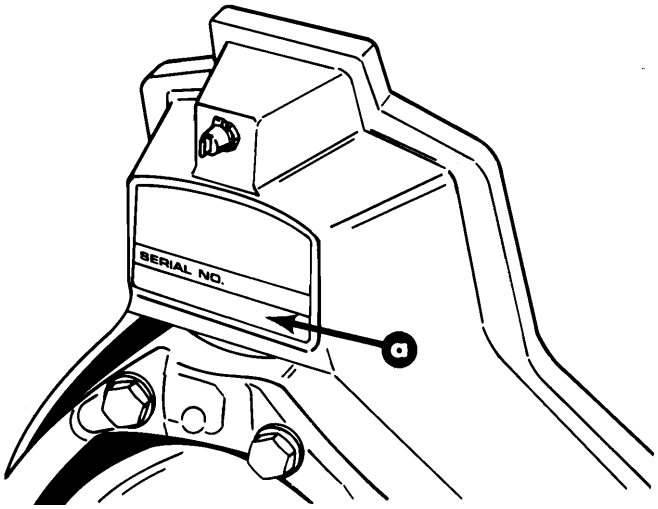


Right Hand Rotation



Left Hand Rotation

Serial Number Locations



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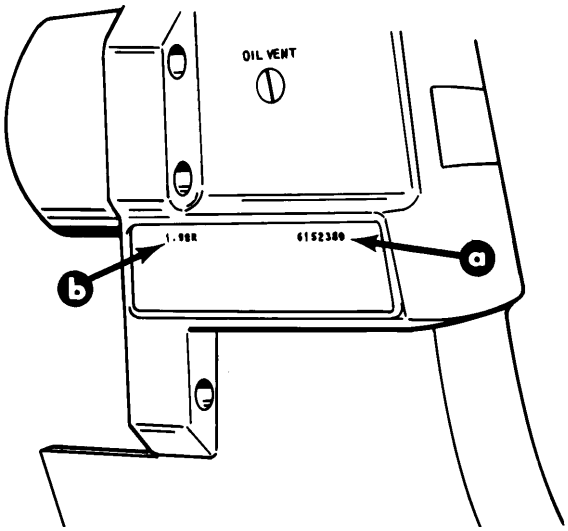
Transom Assembly Serial Number Location

a - Transom Assembly Serial Number



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Sterndrive Unit Serial Number Location – Port Decal

a - Sterndrive Unit Serial Number
b - Sterndrive Unit Gear Ratio

Hi-Performance Boating

Written by marine engineers, order Part No. 90-86168, entitled “Hi-Performance Boat Operation.”

Sterndrive Unit 10-Hour Break-In Period (New or with Replacement Gears)

1. Avoid full throttle starts.
2. DO NOT operate at any one constant speed for extended periods of time.
3. DO NOT exceed 75% of full throttle during the first 5 hours. During the next 5 hours, operate at intermittent full throttle.
4. Drive unit should be shifted into forward gear a minimum of 10 times during break-in, with run-in time at moderate RPM after each shift.

Decal Application

Decal Removal

1. Mark decal location before removal to assure proper alignment of new decal.
2. Carefully soften decal and decal adhesive with a heat gun or heat blower while removing old decal.
3. Clean decal contact area with a 1:1 mixture of isopropyl alcohol and water.
4. Thoroughly dry decal contact area and check for a completely cleaned surface.

TEMPERATURE

IMPORTANT: Installation of vinyl decals should not be attempted while in direct sunlight. Air and surface temperature should be between 60°F (15°C) and 100°F (38°C) for best application.

SURFACE PREPARATION

IMPORTANT: Do not use a soap or any petroleum based solvents to clean application surface.

Decal Application

NOTE: *Ensure area where decal will be applied is clean.*

1. Remove backing from decal.
2. Apply to drive unit.
3. Carefully smooth decal on surface.

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Painting Procedures

Cleaning & Painting Aluminum Propellers & Gear Housings

⚠ WARNING

Avoid serious injury from flying debris. Avoid serious injury from airborne particles. Use eye and breathing protection with proper ventilation.

PROPELLERS

1. Sand the entire area to be painted with 3M 120 Regalite Polycut or coarse Scotch-Brite, disc or belts.
2. Feather edges of all broken paint edges. Try not to sand through the primer.
3. Clean the surface to be painted using PPG Industries DX330 Wax and Grease Remover or equivalent (Xylene or M.E.K.).
4. If bare metal has been exposed, use Quicksilver's Light Gray Primer.
5. Allow a minimum of 1 hour dry time and no more than 1 week before applying the finish coat.
6. Apply the finish coat using Quicksilver's EDP Propeller Black.

GEAR HOUSINGS

The following procedures should be used in refinishing gear housings. This procedure will provide the most durable paint system available in the field. The materials recommended are of high quality and approximate marine requirements. The following procedure will provide a repaint job that compares with a properly applied factory paint finish. It is recommended that the listed materials be purchased from a local Ditzler Automotive Finish Supply Outlet. The minimum package quantity of each material shown following is sufficient to refinish several gear housings.

Procedure:

1. Wash gear housing with a muriatic acid base cleaner to remove any type of marine growth and rinse with water, if necessary.
2. Wash gear housing with soap and water, then rinse.
3. Sand blistered area with 3M 180 grit sandpaper or P180 Gold Film Disc to remove paint blisters only. Feather edge all broken paint edges.
4. Clean gear housing thoroughly with (DX-330) wax and grease remover.
5. Spot repair surfaces where bare metal is exposed with (DX-503) alodine treatment.

IMPORTANT: Do not use any type of aerosol spray paints as the paint will not properly adhere to the surface nor will the coating be sufficiently thick to resist future paint blistering.

6. Mix epoxy chromate primer (DP-40) with equal part catalyst (DP-401) per manufacturer's instructions, allowing proper induction period for permeation of the epoxy primer and catalyst.
7. Allow a minimum of one hour drying time and no more than one week before top coating assemblies.
8. Use Ditzler Urethane DU9000 for Mercury Black and DU33414M for Sea Ray White. Catalyze all three colors with Ditzler DU5 catalyst mixed 1:1 ratio. Reduce with solvents per Ditzler label.

⚠ CAUTION

Be sure to comply with instructions on the label for ventilation and respirators. Using a spray gun, apply one half to one mil even film thickness. Let dry, flash off for five minutes and apply another even coat of one half to one mil film thickness. This urethane paint will dry to the touch in a matter of hours, but will remain sensitive to scratches and abrasions for a few days.

9. The type of spray gun used will determine the proper reduction ratio of the paint.

IMPORTANT: Do not paint sacrificial trim tab or anode.

10. Cut out a cardboard "plug" for trim tab pocket to keep paint off of mating surface to maintain good continuity circuitry between trim tab and gear housing.

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/ater·Pickups·--·Check·for·marine· s.	
pect·condition·and·check·tension.	Every·100·hours·of·operation·or·120· whichever·occurs·first.
--Lubricate.	**Saltwater·Use:**·Every·50·hours·of·op days,·whichever·occurs·first. **Freshwater·Use:**·Every·100·hours·o 120·days,·whichever·occurs·first.
·-·Exterior·Surfaces·--·Spray·with·rust·	
·Exterior·Surfaces·--·Clean·and·	Once·a·year
·-·Flush·seawater·section.	**Saltwater·Use:**·After·every·use.

MAINTENANCE

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Maintenance Schedules

Maintenance Intervals

Maintenance intervals and the tasks to be performed, as shown in this current schedule, or as found in a previously printed schedules, are generally based on an average boating application and environment. However, individual operating habits and personal maintenance preferences can have an impact on the suggested intervals. In consideration of these factors, MerCruiser has adjusted some maintenance intervals and corresponding tasks to be performed. In some cases, this may allow for more individual tasks to be performed in a single visit to the serving dealer, rather than multiple visits. Therefore, it is very important that the boat owner and servicing dealer discuss the current Maintenance Schedule and develop appropriate maintenance intervals to coincide with the individual operating habits, environment and maintenance requirements.

Scheduled Maintenance That Can Be Performed By Owner/Operator

NOTE: *Only perform maintenance which applies to your particular power package.*

Task	Interval
Engine Crankcase Oil - Check level.	Weekly
Closed Cooling Coolant - Check level.	
Power Steering Fluid - Check level.	
Sterndrive Unit Oil - Check level.	
Battery - Check level and inspect for damage.	
Fuel Pump Sight Tube (If Equipped) - Check that no fuel is present.	
Power Trim Pump Oil - Check level.	
Anodes - Inspect for erosion.	
Gear Housing Water Pickups - Check for marine growth or debris.	
Drive Belts - Inspect condition and check tension.	Every 100 hours of operation or 120 days, whichever occurs first.
Propeller Shaft - Lubricate.	**Saltwater Use**: Every 50 hours of operation or 60 days, whichever occurs first. **Freshwater Use:** Every 100 hours of operation or 120 days, whichever occurs first.
Power Package - Exterior Surfaces - Spray with rust preventative.	
Power Package Exterior Surfaces - Clean and paint.	Once a year
Cooling System - Flush seawater section.	**Saltwater Use:** After every use.

Scheduled Maintenance That Can Be Performed by Dealer

NOTE: *Only perform maintenance which applies to your particular power package.*

Task	Interval
Seawater Pickup Pump - Disassemble and inspect.	Whenever insufficient seawater flow is suspected. (If operating temperature exceeds normal range.)
Crankcase Oil and Filter - Change.	End of first boating season and thereafter, every 100 hours of operation or once yearly, whichever occurs first.
Ignition system - Clean and inspect condition.	
Flame Arrestor and Crankcase Ventilation Hose - Clean and inspect.	
Positive Crankcase Ventilation (PCV) Valve (If Equipped) - Change.	
Sterndrive Unit Oil - Change.	
Gimbal Ring Clamping Screws - Retorque to 50-55 ft. lb. (67-74 N·m).	
Rear Engine Mounts - Check torque to 30-40 ft. lb. (47-54 N·m).	
Gimbal Bearing - Lubricate.	
Cooling System - Clean and inspect.	
Steering System - Lubricate and inspect for loose, damaged or missing parts.	
Electrical System - Check for loose or damaged wiring.	
Closed Cooling System Pressure Cap - Clean, inspect and test .	
Cooling System Hoses and Clamps - Inspect for damage and deterioration. Check clamps for tightness.	
Continuity Circuit - Check components for loose connections, broken or frayed wires.	
Shift and Throttle Cable and Linkage - Lubricate and inspect for loose, damaged or missing parts.	
Engine Exhaust System - Inspect externally for damage, deterioration and restrictions. Check for tightness.	
Ignition System - Check timing and adjust as needed.	

Scheduled Maintenance That Can Be Performed by Dealer (Continued)

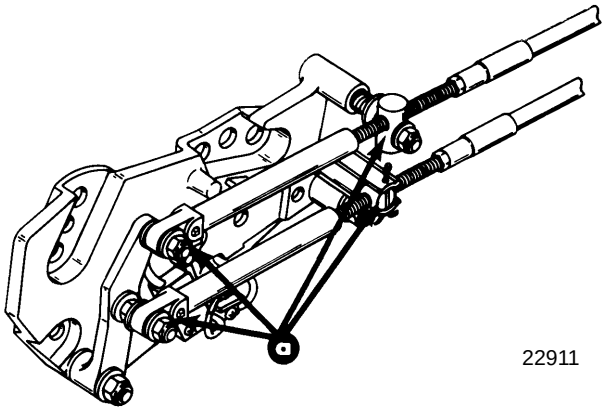
NOTE: *Only perform maintenance which applies to your particular power package.*

Task	Interval
Steering Head and Remote Control - Inspect and lubricate.	End of first boating season and thereafter, every 100 hours of operation or once yearly, whichever occurs first.
Carburetor - Inspect and adjust.	
Fuel Filters - Replace.	Once a Year
Quicksilver Mercathode System - Test output.	
Closed Cooling Coolant - Test for alkalinity.	
Heat Exchanger - Clean seawater section.	
Drive Unit Bellows and Clamps - Inspect.	
Engine Alignment - Check.	End of first boating season and thereafter, **Saltwater Use:** Every 300 hours of operation or once yearly, whichever occurs first **Freshwater Use:** Every 300 hours of operation or once every two years, whichever occurs first.
Engine Coupling Universal Joint Shaft Splines - Lubricate.	
Universal Joint Cross Bearings- Inspect.	
Closed Cooling Coolant - Replace.	Every Five Years

[1]Only if Extended Life 5/100 Ethylene Glycol Antifreeze/Coolant is used. If any non-compatible coolant is added to this coolant, coolant must be changed every 2 years or 400 hours, whichever occurs first. All coolants other than Extended Life 5/100 Ethylene Glycol Antifreeze/Coolant must be changed every 2 years or 400 hours, whichever occurs first.

Lubricating Shift Cable Pivot Points

1. Lubricate with SAE 20 or SAE 30 Oil.



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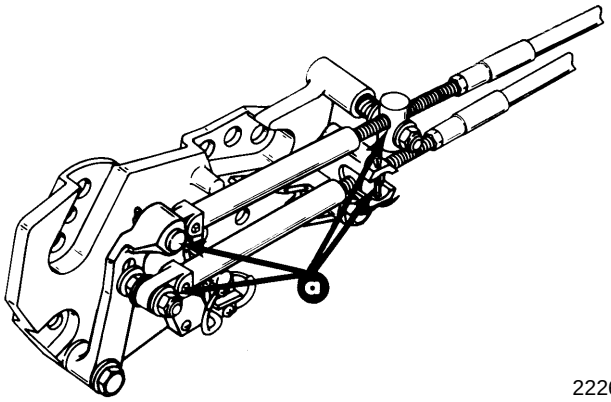
Early Models



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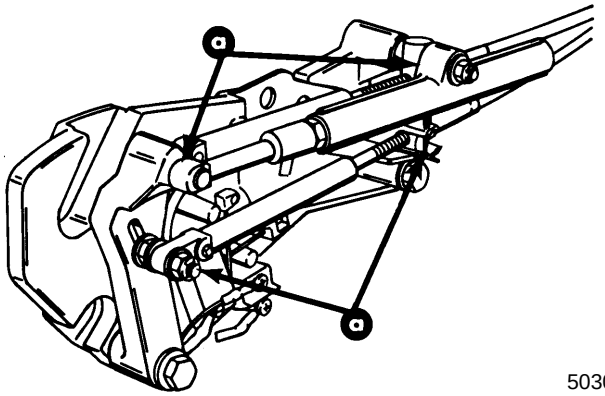
Later Models



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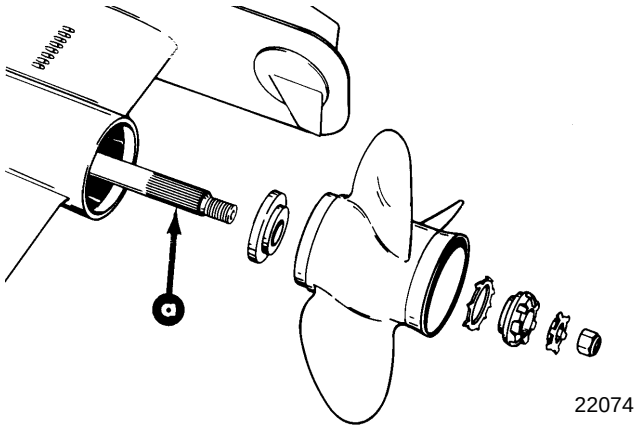
Models With Shift Assist Assembly

a - Lubrication Points

Lubricating Propeller Shaft

1. Lubricate with Special Lubricant 101, 2-4-C Marine Lubricant With Teflon or Perfect Seal (listed in order of effectiveness).



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a - Lubrication Point

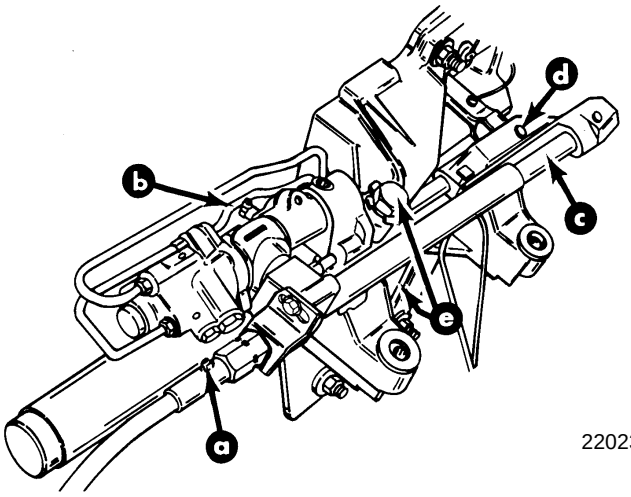
Lubricating Steering System

⚠ WARNING

Transom end of steering cable MUST BE fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

Power Steering Models

1. Lubricate following points with specified lubricant.



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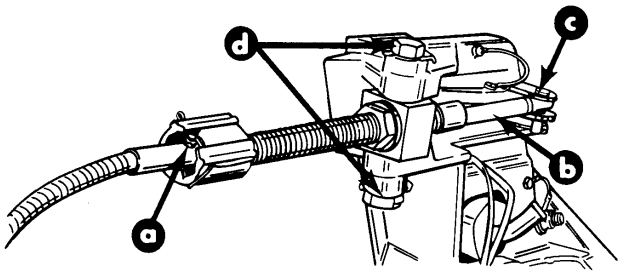
a - Steering Cable Grease Fitting - 2-4-C Marine Lubricant With Teflon (See Previous Warning)
b - Control Valve Grease Fitting - 2-4-C Marine Lubricant With Teflon
c - Steering Cable End - Special Lubricant 101
d - Pivot Point - SAE 20 Or 30 Engine Oil
e - Pivot Bolts - Special Lubricant 101

Manual Steering Models



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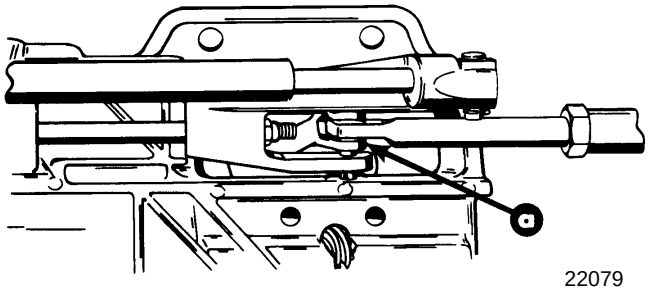
a - Steering Cable Grease Fitting - 2-4-C Marine Lubricant With Teflon
b - Steering - Cable End And Exposed Portion - Special Lubricant 101
c - Pivot Points - SAE 20 Or 30 Engine Oil
d - Pivot Bolts - Special Lubricant 101
e - Lubricating Tie Bar Pivot Points

Lubricating Tie Bar Pivot Points

CONTROL VALVE MOUNTED ON STARBOARD TRANSOM

1. Lubricate pivot points with SAE 20 or SAE 30 oil.



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Starboard Engine

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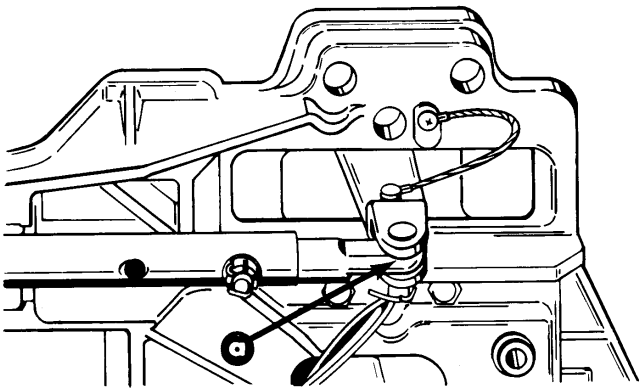


22079

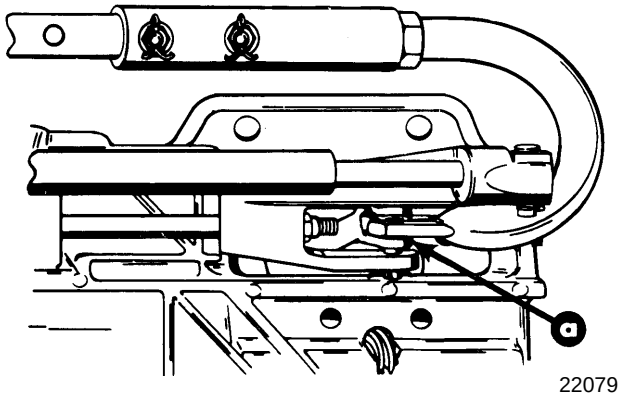
Port Engine

a - Pivot Points

Lubricating Tie Bar Pivot Points

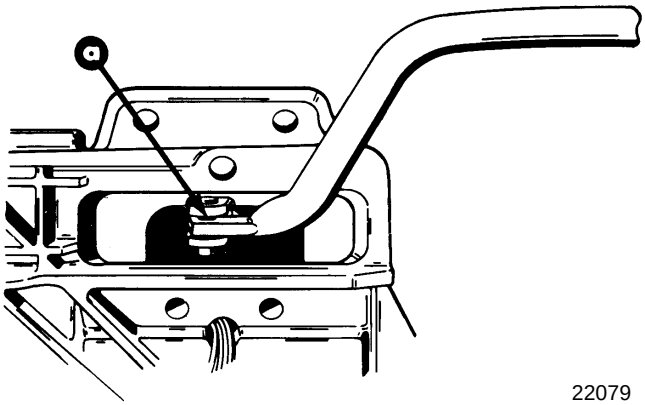
CONTROL VALVE MOUNTED ON PORT TRANSOM

1. Lubricate pivot points with SAE 20 or SAE 30 oil.



22079

Port Engine



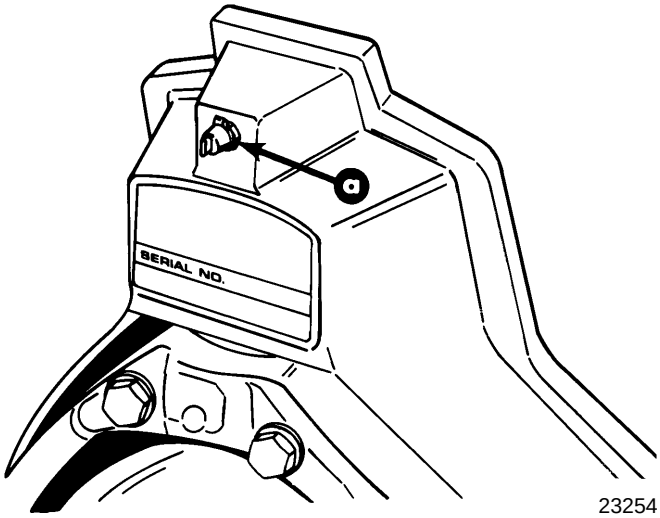
22079

Starboard Engine

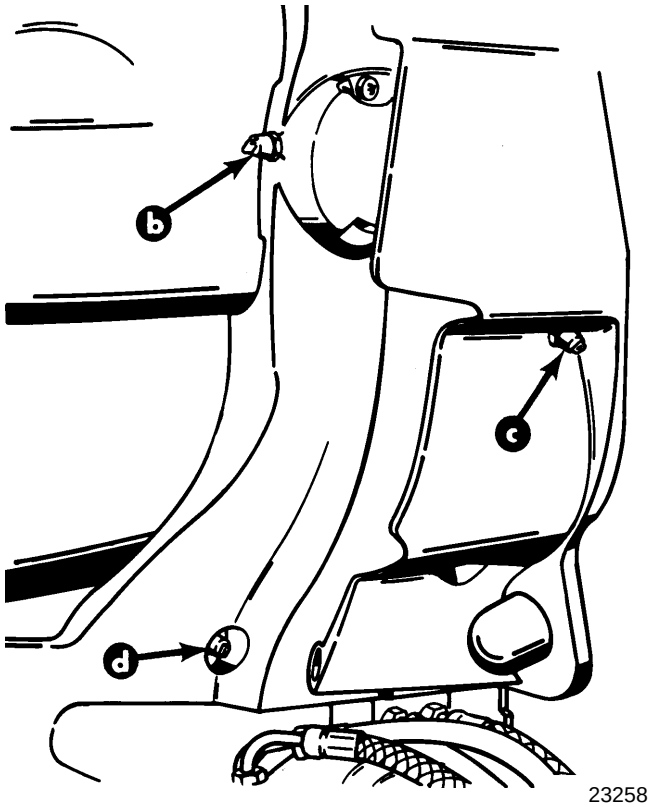
a - Pivot Points

Lubricating Transom Gimbal Housing Assembly Swivel Shaft, Swivel Pin, Hinge Pins and Gimbal Bearing

1. Lubricate the following points with specified lubricant.



23254



23258

a - Swivel Shaft (Later Models May Not Be Equipped With Fitting) [2-4-C Marine Lubricant With Teflon]
b - Hinge Pin (One Each Side) [2-4-C Marine Lubricant With Teflon]
c - Gimbal Bearing (U-Joint And Gimbal Bearing Grease)
d - Swivel Pin (2-4-C Marine Lubricant With Teflon)

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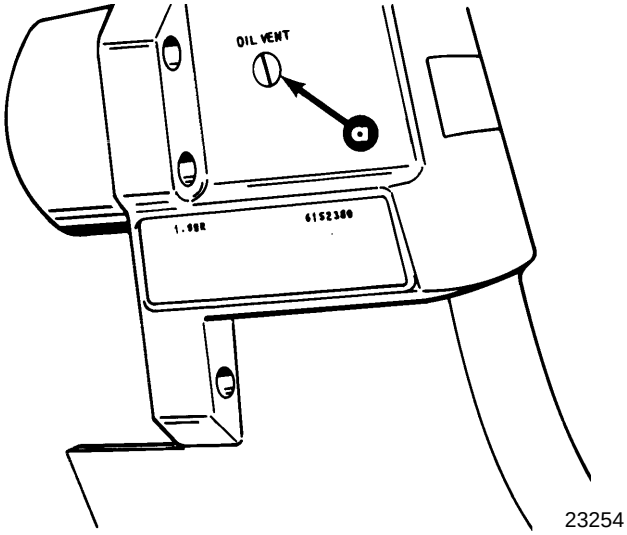
Checking and Adding Sterndrive Oil

Units Without Gear Lube Monitor

1. Position sterndrive unit so that anti-ventilation plate is level.
2. Remove oil vent plug from drive shaft housing.
3. Check oil level - Oil should be even with bottom edge of oil vent hole. If oil is at proper level, reinstall vent screw and sealing washer. If oil level is low, proceed with next steps.

⚠ CAUTION

DO NOT attempt to fill drive unit through oil vent hole, as air will be trapped in drive unit and unit will be damaged from lack of lubricant.



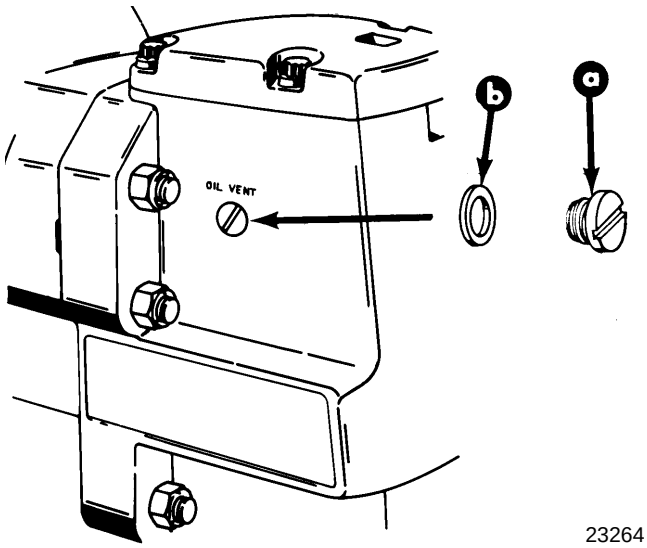
23254

a - Oil Vent Screw

⚠ CAUTION

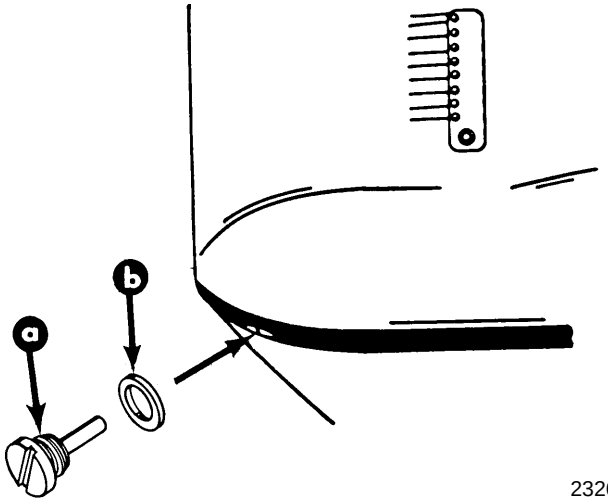
If more than 2 fl. oz. (60 ml) of oil is required to fill drive unit, an oil leak may exist. Find and correct cause of leak before unit is placed in operation.

4. If oil level is low, reinstall oil vent screw and sealing washer. Remove oil fill/drain screw and insert lubricant pump into oil fill/drain hole.
5. Remove oil vent screw. Fill drive unit (through oil fill/drain hole) with oil until an an air-free stream of oil flows out of oil vent hole.
6. Without removing lubricant pump from fill/drain hole, reinstall vent screw and sealing washer. Torque to 30 - 50 lb. in. (3.4 - 5.7 N·m).
7. Remove lubricant pump and quickly reinstall fill/drain screw and sealing washer. Torque to 30 - 50 lb. in. (3.4 - 5.7 N·m).
8. Recheck oil level after operation of unit.



23264

a - Oil Vent Screw
b - Sealing Washer



23266

a - Oil Fill/Drain Screw
b - Sealing Washer

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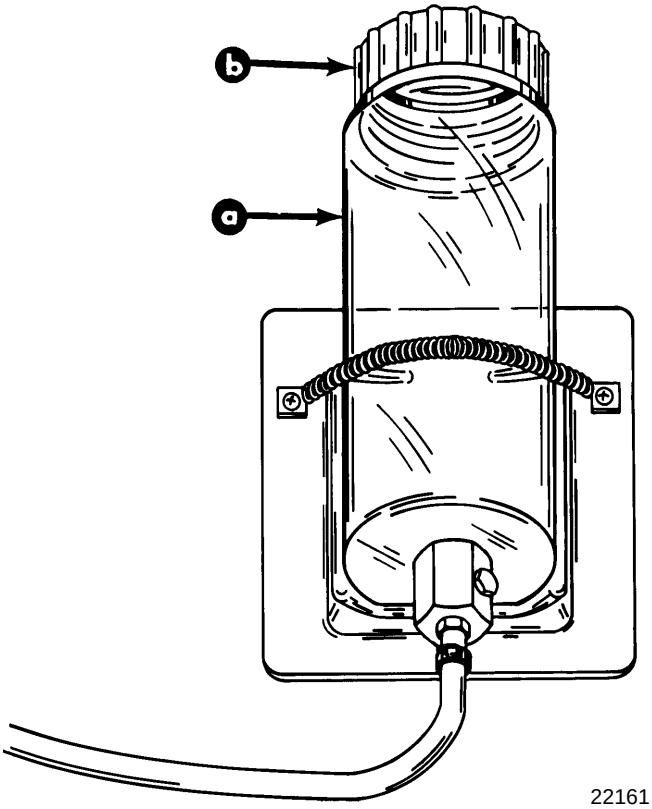
Models With Gear Lube Monitor

IMPORTANT: DO NOT check oil level with drive unit hot from operation, as hot, expanded oil may provide a false reading at reservoir. Allow drive unit to cool prior to checking oil level.

⚠CAUTION

If color of oil appears milky, or if continuous low oil level readings in reservoir are noted, a leak may exist. Find and correct cause for leak before unit is placed in operation.

1. Maintain oil level to “Full” mark on reservoir. DO NOT OVERFILL.
2. Reinstall reservoir cap. Make sure cap is tight.



22161

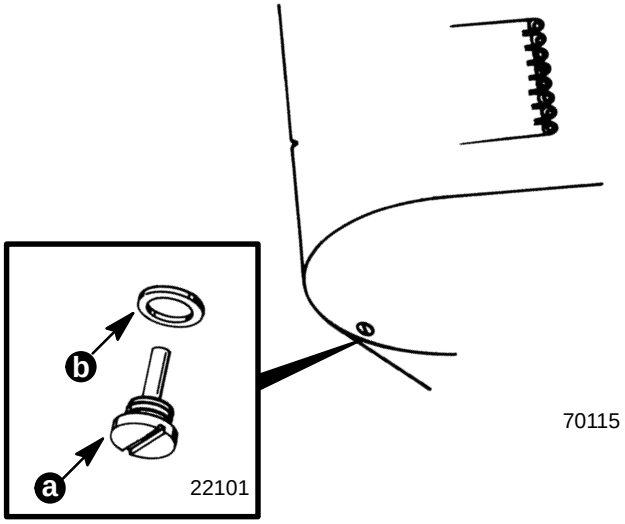
a - Oil Reservoir
b - Cap

Checking Lubricant for Water

Periodically inspect lubricant for water to ensure that drive unit seals are not leaking.

Models Without Gear Lube Monitor

1. Trim drive unit to the full trim UP/OUT position. Remove fill/drain plug to take a sample of lubricant. If water is observed or if lubricant appears discolored, drive unit is leaking and must be resealed.



70115

a - Fill/Drain Plug
b - Sealing Washer Or O-ring

2. Reinstall fill/drain plug. Torque to 30-50 lb. in. (3.4-5.7 N·m).

Models With Gear Lube Monitor

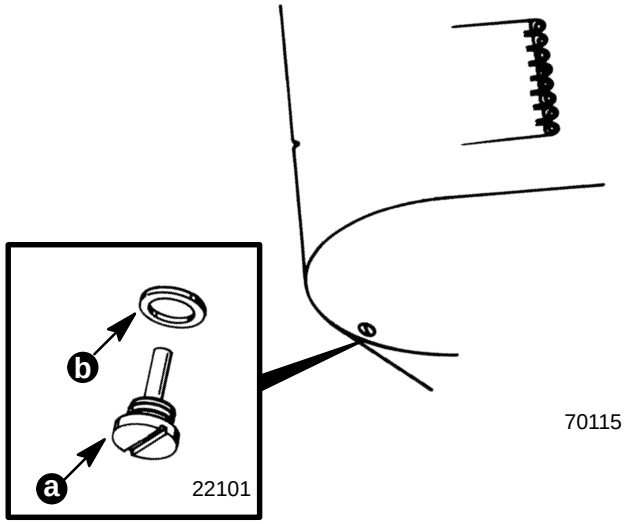
Check for water at bottom of monitor. If oil appears discolored, a water leak is indicated somewhere in the drive unit and the drive unit **must** be resealed.

⚠CAUTION

If more than 2 fl. oz. (59 mL) of Quicksilver Gear Lube is required to fill monitor, a seal may be leaking. Find and correct cause of leak before unit is placed in operation.

IMPORTANT: If drive unit has set overnight or longer, check for water in drive unit as follows:

1. Trim drive unit to full UP/OUT position.



a - Oil Fill/Drain Plug
b - Sealing Washer Or O-ring

2. Remove fill/drain plug to sample lubricant. If water runs out and/or if lubricant appears discolored, drive unit is leaking and **must** be resealed.
3. Reinstall fill/drain plug. Torque to 30-50 lb. in. (3.4-5.7 N·m).

Changing Sterndrive Oil

Models Without Gear Lube Monitor

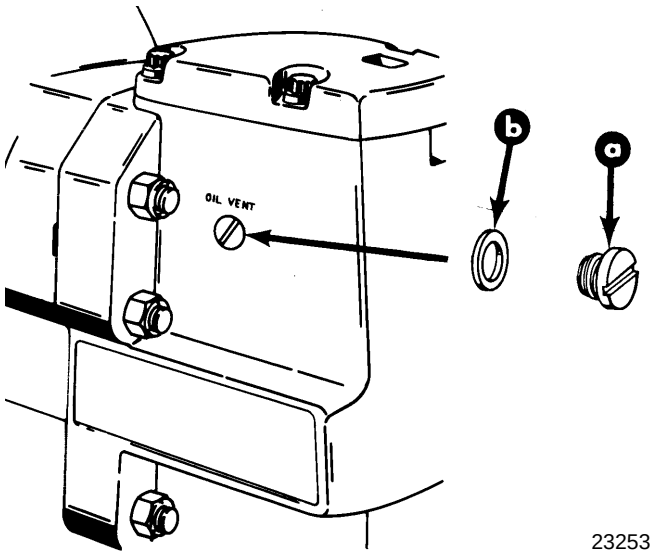
⚠CAUTION

If any water drains from fill/drain hole, or if oil is discolored, a leak in drive unit may exist. Find and correct cause of leak before placing unit back in operation.

⚠CAUTION

DO NOT attempt to fill drive unit thru oil vent hole, as air will be trapped in drive unit and unit will be damaged from lack of lubricant.

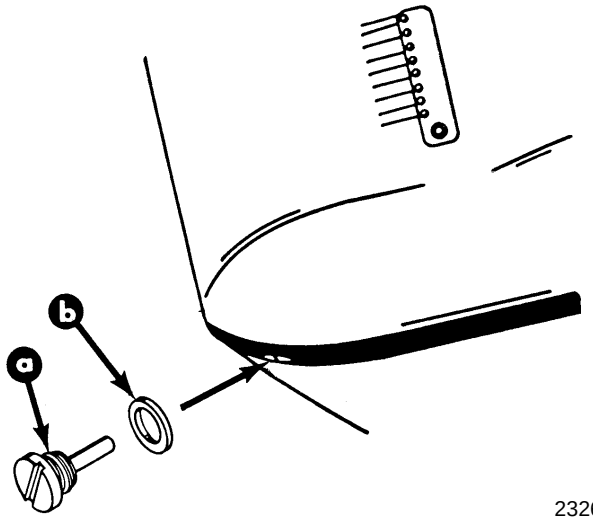
4. Remove fill/drain screw and vent plug from drive unit, and allow oil to drain completely.
5. Position drive unit so that anti-ventilation plate is level.



a - Oil Vent Screw
b - Sealing Washer

6. Using lubricant pump, fill drive unit through fill/drain hole until oil level is even with bottom edge of vent hole.
7. Without removing lubricant pump from fill/drain hole, reinstall oil vent plug and sealing washer. Torque to 30 - 50 lb. in. (3.4 - 5.7 N•m).

8. Remove lubricant pump and quickly reinstall fill/drain screw and sealing washer. Torque to 30 - 50 lb. in. (3.4-5.7 N·m).
9. Recheck oil level after first use.



23266

a - Oil Fill/Drain Plug
b - Sealing Washer

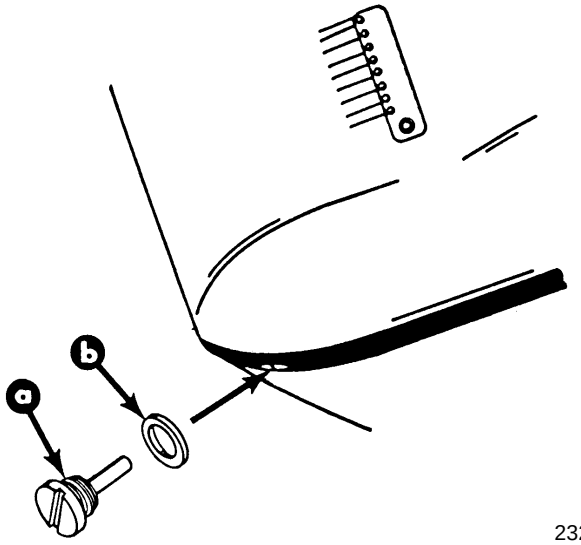
Units With Gear Lube Monitor

1. Raise drive unit to the full trim OUT position.

⚠CAUTION

If any water drains from fill/drain hole, or if oil color appears milky, a leak in drive unit is indicated. Find and correct cause of leak before placing unit back in operation.

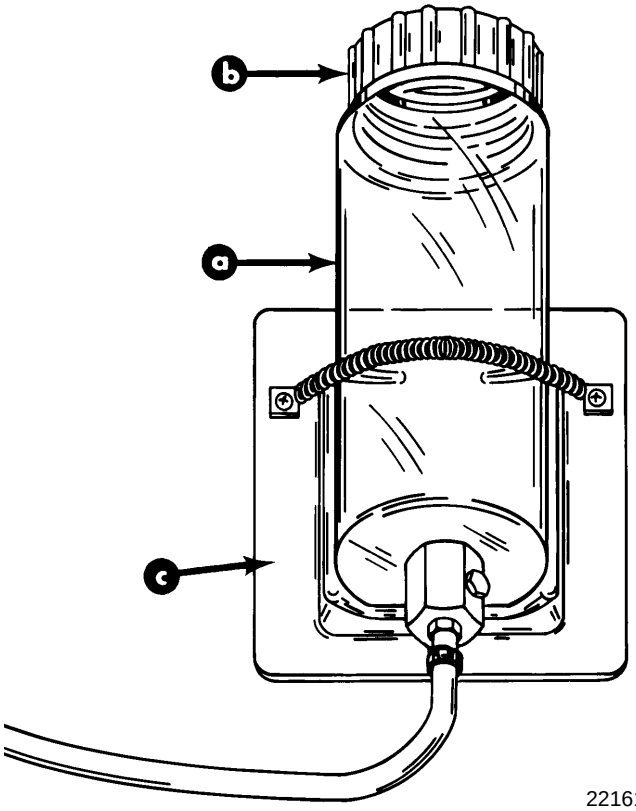
2. Remove fill/drain screw and remote oil reservoir cap and allow oil to drain completely.



23266

a - Oil Fill/Drain Screw
b - Sealing Washer

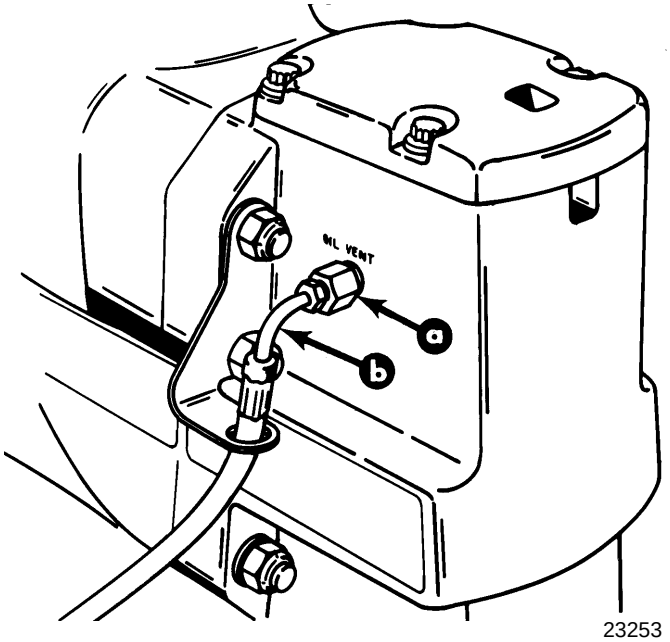
3. Remove reservoir from bracket and remove any remaining oil from reservoir.



22161

a - Oil Reservoir
b - Cap
c - Bracket

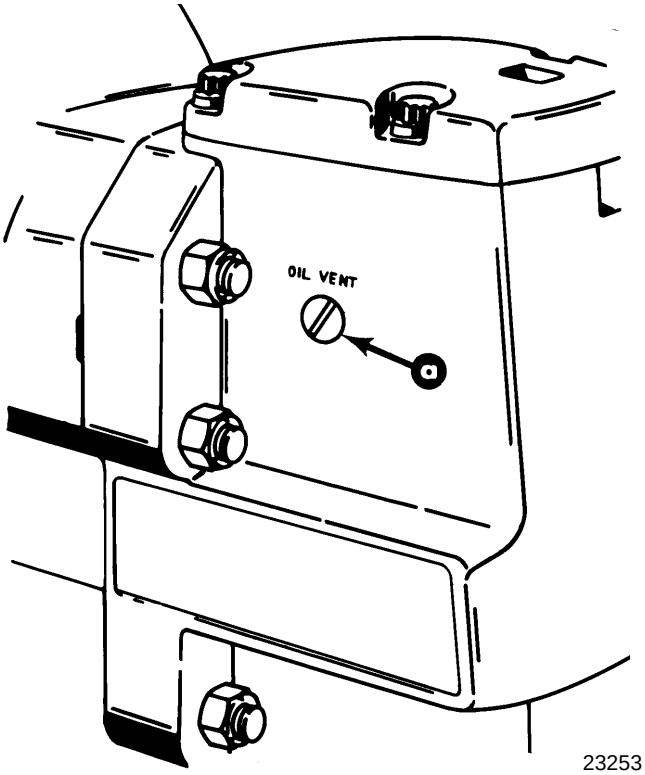
4. Remove hose and adapter from vent hole.



23253

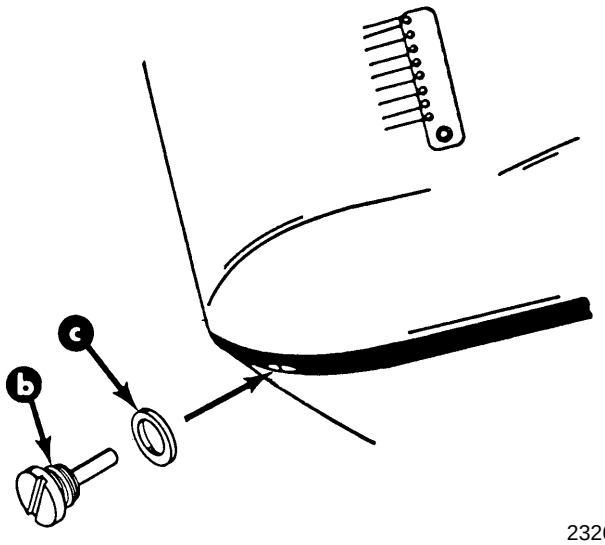
a - Adapter and Seal
b - Hose

5. Position sterndrive unit so that anti-ventilation plate is level.
6. Using lubricant pump, fill drive unit through fill/drain hole until an air-free stream of oil flows out of vent hole.
7. Temporarily plug vent hole.
8. Remove lubricant pump and quickly reinstall fill/drain screw and sealing washer.



23253

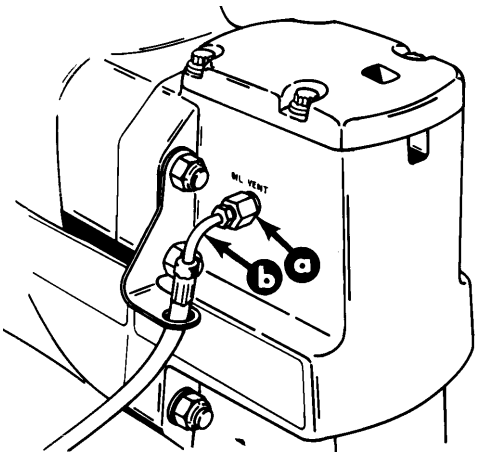
a - Vent Hole



23266

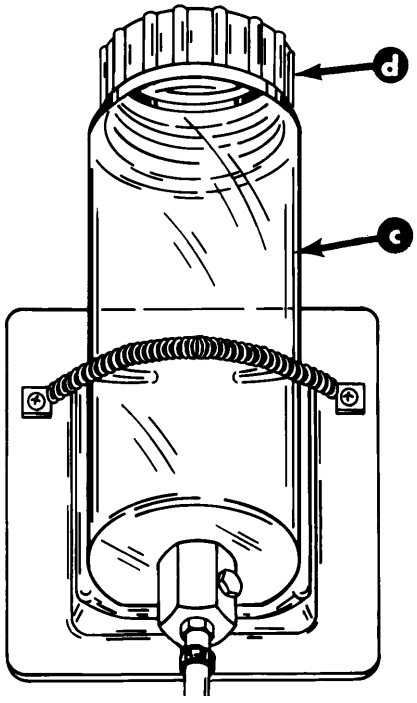
b - Fill/Drain Screw
c - Sealing Washer

9. Unplug vent hole; then, install adapter and sealing washer into vent hole. Torque adapter to 30 - 50 lb. in. (3.4-5.7 N·m). Install reservoir hose and tighten fitting LOOSELY.
10. Fill oil reservoir to “Fill” mark. DO NOT OVER-FILL. Install cap and tighten securely.
11. Loosen hose fitting from adapter until an air-free stream of oil flows from between adapter and hose fitting; then, torque hose fitting to 30 - 50 lb. in. (3.4-5.7 N·m).
12. If necessary, add oil to reservoir up to “Full” mark.



23253

a - Adapter
b - Hose Fitting



22161

c - Oil Reservoir
d - Cap

13. Recheck oil level after first use.

General Maintenance

Maintaining Power Package Exterior Surfaces

Entire Power Package should be sprayed at recommended intervals with Quicksilver Corrosion and Rust Preventive Type II. Follow instructions on can for proper application.

At least once each year, entire Power Package should be cleaned and external surfaces, which have become bare, should be repainted with Quicksilver Primer and Spray Paint.

Steering Head and Remote Control Maintenance

Lubricate steering head and remote control with 2-4-C Marine Lubricant. Inspect steering head and remote control for ease of operation.

Checking Quicksilver MerCathode System

If boat is equipped with a Quicksilver MerCathode System, system should be tested to ensure that it is providing adequate output to protect underwater metal parts on boat. Test should be made where boat is moored, using Quicksilver Reference Electrode and Test Meter. Refer to SECTION 7.

Maintaining Alloy Trim Tab and Anodic Heads

Sterndrive unit is equipped with a sacrificial alloy trim tab and 2 anodic heads to help protect underwater metal parts from galvanic corrosion. Because of their self-sacrificing nature, trim tab and anodic heads MUST BE replaced if eroded 50% or more. To replace trim tab and/or anodic heads, proceed as follows:

REPLACING TRIM TAB

⚠CAUTION

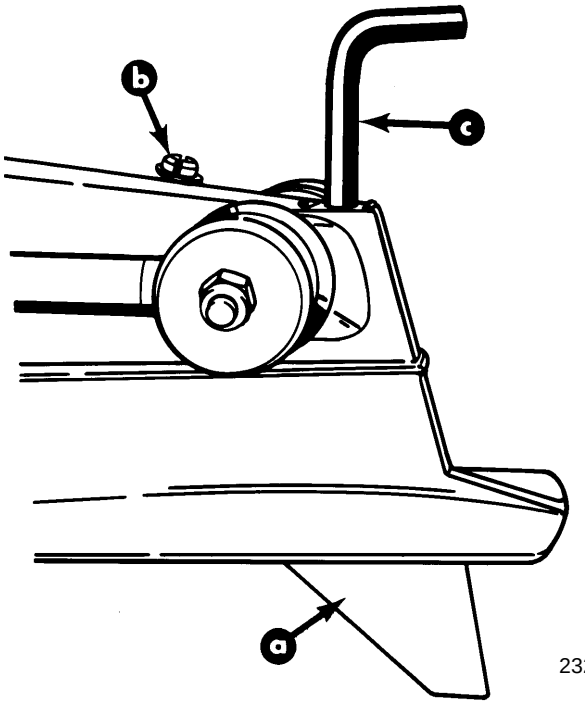
DO NOT paint new trim tab, as this will render it ineffective as a galvanic corrosion inhibitor.

1. Mark position of trim tab fin in relation to gear housing so that new trim tab can be installed in same relative position. If power package is equipped with Power Steering, trim tab is positioned with fin straight back.
2. Remove plug from drive shaft housing to gain access to trim tab attaching screw (not shown in photo).
3. Use a 3/8 in. allen wrench and unthread trim tab attaching screw from trim tab - DO NOT attempt to remove trim tab attaching screw.

⚠CAUTION

To be effective, new trim tab MUST make good electrical contact with gear housing.

4. Scrape trim tab mounting surface on gear housing down to bare metal.
5. Install trim tab, aligning trailing edge with index mark made in Step 1. Tighten screw securely.
6. Reinstall plug in drive shaft housing.
7. If power package is equipped with manual steering, adjust trim tab.



23253

a - Trim Tab
b - Plug
c - 3/8 in. Allen Wrench

Maintaining Continuity Circuit

Transom assembly and sterndrive unit may be equipped with a continuity circuit to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the anodes and MerCathode System (if equipped) to function most effectively.

Inspect the following continuity circuit components, at intervals specified in “Maintenance Chart,” for loose connections or broken or fraying wires. Refer to SECTION 7.

REPLACING ANODIC HEADS - ONE EACH SIDE

⚠CAUTION

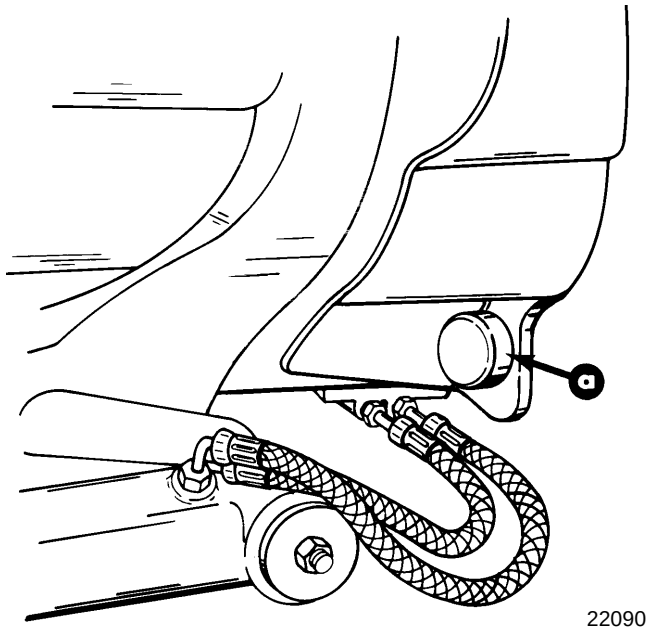
DO NOT paint new anodic heads, as this will render them ineffective as galvanic corrosion inhibitors.

1. Remove anodic heads and gaskets (not seen) by turning counterclockwise with a pair of pliers.

⚠CAUTION

To be effective, new anodic heads MUST make good electrical contact with gimbal housing.

2. Clean anodic head mounting surfaces.
3. Install new heads (using new gaskets) and tighten securely.



22090

a - Anodic Heads (One Each Side)

Checking Optional Quicksilver Anti-Corrosion Anode Kit

If boat is equipped with Quicksilver Anti-Corrosion Anode Kit, inspect anode and replace if eroded to less than 50% of its original size. Carefully follow installation instructions that accompany new Anode Kit to ensure proper installation.

Boat Bottom Care

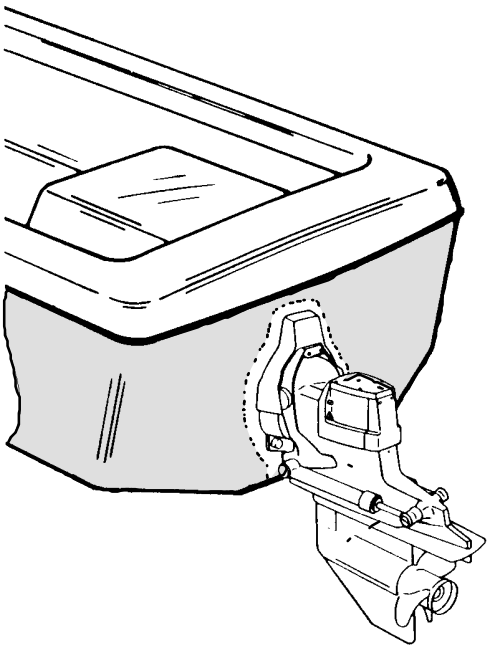
To achieve maximum performance and fuel economy, boat bottom MUST BE kept clean. Accumulation of marine growth or other foreign matter can greatly reduce boat speed and increase fuel consumption. To ensure best performance and efficiency, periodically clean boat bottom in accordance with manufacturer’s recommendations. In some areas, it may be advisable to paint bottom to help prevent marine growth.

⚠CAUTION

DO NOT paint anodes or MerCathode System anode and reference electrode, if equipped, as this will render them ineffective as a galvanic corrosion inhibitors.

IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint will not be covered by the limited warranty.

If anti-fouling protection is required for boat hull or boat transom, copper or tin base paints, if not prohibited by law, can be used. If using copper or tin based anti-fouling paint, avoid any electrical interconnection between the MerCruiser product, anodic blocks, or MerCathode system and the paint. Allow a minimum of $1^1/_2$ in. (40 mm) of UNPAINTED area around these items to ensure that there is no interconnection.



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Paint the drive unit and transom assembly with a good quality marine paint or anti-fouling paint that DOES NOT contain copper, tin, or any other material that could conduct electrical current. Do not paint drain holes, anodes, MerCathode system, or items specified by the boat manufacturer.

Spray power package components inside the boat every 2 - 3 weeks with Quicksilver Corrosion Guard to protect the finish from dulling and corrosion. External power package components may also be sprayed.

All lubrication points, especially steering system, shift and throttle linkages should be kept well lubricated. Flush the cooling system periodically, preferably after each use.

Power Package Layup (Out of Season Storage)

Engine

Refer to appropriate Engine Service Manual.

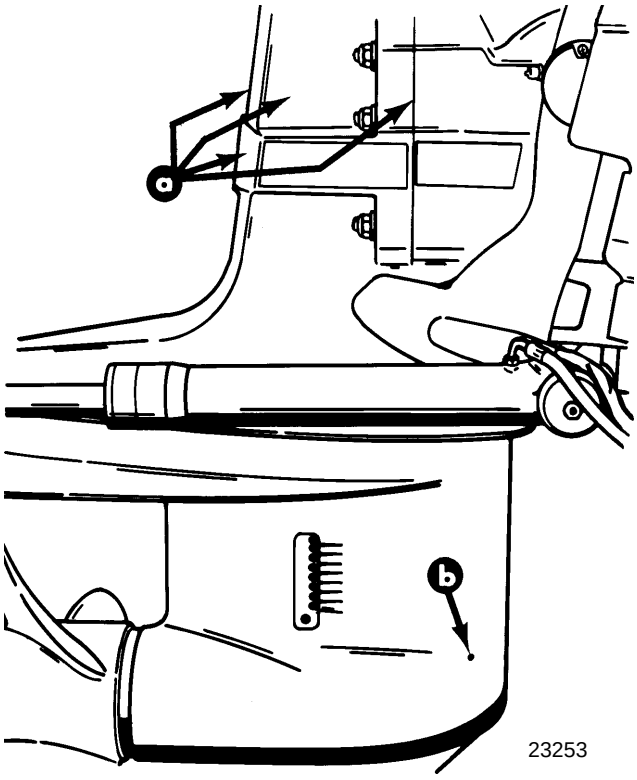
Sterndrive

1. Lubricate steering system. Refer to SECTION 1-B.
2. Lubricate transom gimbal housing assembly swivel shaft and pin, hinge pins, gimbal bearing and propeller shaft. Refer to SECTION 1-B.
3. Lubricate sterndrive unit U-Joint shaft splines and cross bearings. Refer to SECTION 3-A.
4. Inspect U-Joint bellows for cracks or other signs of deterioration. Check bellows clamps for tightness. Refer to SECTION 4.
5. Check engine alignment. Refer to Engine Service Manual.
6. Change sterndrive unit oil.

⚠CAUTION

Water drain holes in sterndrive unit MUST BE open to allow water to drain, or trapped water may freeze and cause severe damage to housings.

7. Using a piece of wire, check water drain holes in sterndrive unit to ensure that they are open.



Sterndrive Unit Water Drain Holes

a - Drive Shaft Housing Water Drain Holes (Two Each Side)
b - Gear Housing Water Drain Hole

8. Inspect sterndrive for damage. Repair or replace damaged components.
9. Clean sterndrive exterior surfaces and repaint any bare metal surfaces with Quicksilver Primer and Spray Paint. Refer to SECTION 1-B.
10. After paint has dried spray entire sterndrive with Quicksilver Corrosion Guard. Refer to SECTION 1-B.

⚠ CAUTION

The gear case exhaust cavity might fill with water and freeze if stored in the UP/OUT position. Avoid gear case damage by storing the sterndrive unit in the full IN/DOWN position.

⚠ CAUTION

U-Joint bellows may develop a "set" if unit is stored in raised position and may fail when unit is returned to service. Store sterndrive unit in the full trim IN/DOWN position.

11. If not already done, place sterndrive unit in the full trim IN/DOWN position.
12. Store battery, using the following procedure.
    a. Remove battery as soon as possible and remove all grease sulfate and dirt from top surface.
    b. Fill battery with distilled water to level specified by manufacturer.
    c. Cover terminal bolts well with petroleum base grease.
    d. Store battery in a COOL, DRY place in a dry carton or box.

⚠ CAUTION

A discharged battery can be damaged by freezing.

    e. Remove battery from storage every 45 days. Check water level and place on charge, following battery manufacturer's instructions. DO NOT fast charge.

NOTE: *Larger batteries generally will accept a higher charging rate.*

    f. When replacing battery in service, remove excess grease from terminals (leaving small amount on), recharge as necessary and reinstall in your equipment.

Power Package Recommissioning

Engine

Refer to appropriate Engine Service Manual.

Sterndrive

1. Perform ALL maintenance specified for completion "At Least Once Each Year" in "Maintenance Chart" (In Front of This Section), except items which were performed at the time of sterndrive lay up.
2. Install fully-charged battery. Clean battery cable clamps and terminals and reconnect cables. Be sure to tighten clamps securely. Apply a thin coat of petroleum base grease to clamps and terminals to help retard corrosion.
3. After recommissioning and starting engine, check steering system and shift control for proper operation.

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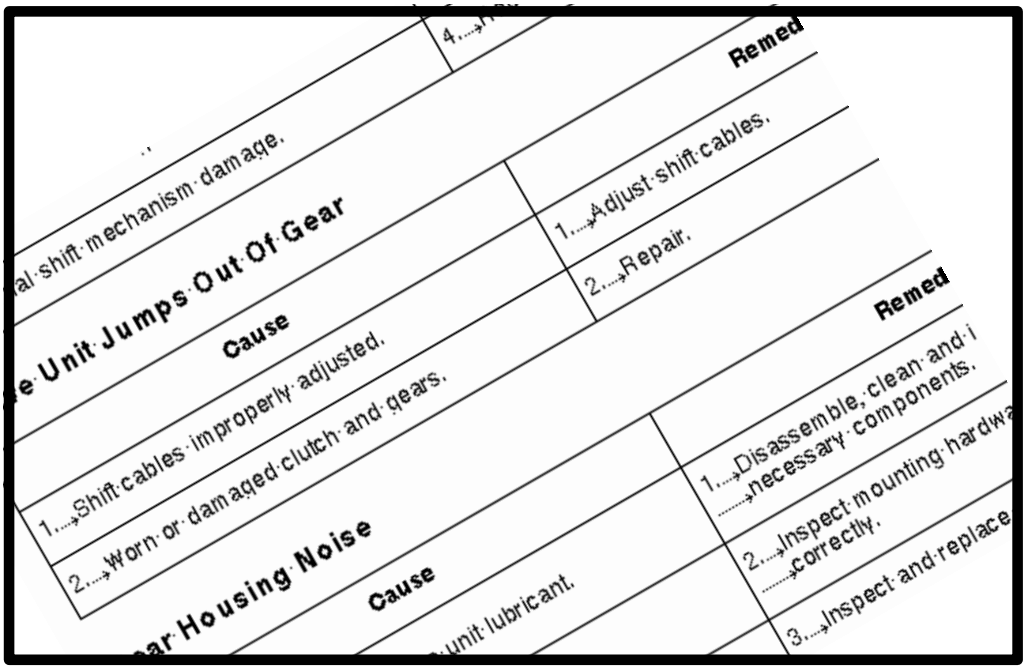
GENERAL INFORMATION

1

C



TROUBLESHOOTING

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Troubleshooting

This section is a guide for performance and product troubleshooting. Referrals to specific sections of this manual are made where special tests or repair procedures are to be performed.

Because of the relationship between Power Package components (engine and sterndrive), it will be necessary, in some cases, to simultaneously refer to the appropriate Engine Service Manual for further trouble shooting information.

Effective troubleshooting is best enhanced by:

- Personal product knowledge and experience of the trained mechanic/technician.
- Allowing adequate time for testing and analysis.
- Utilizing these charts as a “guide” - a starting point.

Sterndrive Unit Troubleshooting

Sterndrive Unit Will Not Slide Into Bell Housing

Cause	Remedy
1. U-joint shaft splines not aligned with engine coupler splines.	1. Rotate propeller shaft COUNTERCLOCKWISE to align splines.
2. Engine not aligned.	2. Check engine alignment.
3. Gimbal bearing not properly installed.	3. Check engine alignment to determine if gimbal bearing is cocked, or improperly installed in gimbal housing.
4. Damaged u-joint shaft splines and/or engine coupler splines.	4. Inspect and replace if necessary.
5. Lower shift shaft not in forward gear position. Bell Housing shift shaft not lined up.	5. Properly align shift shafts.
6. Bell housing shift shaft coupler not aligned.	6. Place coupler in forward gear position.

Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Moves

Cause	Remedy
1. Shift cables improperly adjusted.	1. Adjust shift cables.
2. Shift cables not connected.	2. Install and adjust shift cables.
3. Inner core wire broken or loose.	3. Reconnect or replace inner core wire.
4. Gear housing crank improperly installed.	4. Install shift crank properly.

Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Does Not Move

Cause	Remedy
1. Control box not properly assembled.	1. Properly reassemble control box.
2. Broken or damaged linkage in control box.	2. Repair linkage.
3. Controls improperly adjusted-cable end guide hitting brass barrel.	3. Adjust shift cables.
4. Shift shaft or shift shaft lever jammed.	4. Install shift crank properly.
5. Shift cable not installed deep enough into bell housing.	5. Install cable further into bell housing.

Drive Unit Shifts Hard

Cause	Remedy
1. Shift cables improperly adjusted.	1. Adjust shift cables.
2. Damaged remote control or drive unit shift cable.	2. Replace cable(s) and adjust.
3. Shift cable too short (sharp bends) or too long (loops and long bends).	3. Select and install proper length cable.
4. Corroded shift cables.	4. Replace, adjust, and check for water leakage.
5. Internal wear in remote control box.	5. Repair as needed.
6. Shift cable attaching nuts too tight (end cannot pivot).	6. Properly install nuts.
7. Shift cable pivot ends are corroded, or not lubricated.	7. Clean and lubricate.
8. Shift cutout switch improperly adjusted or inoperative.	8. Adjust or replace switch.
10 Shift shaft bushing in bell housing or gear housing corroded.	10. Replace.
11. Shift crank and/or clutch actuating spool worn.	11. Replace crank and spool.
12. Damaged shift shaft bushing.	12. Replace shift shaft bushing.
13. Bent upper, intermediate, or lower shift shaft(s).	13. Inspect and replace.

Drive Unit In Gear, Will Not Shift Out Of Gear

Cause	Remedy
1. Shift cable broken.	1. Replace cable and adjust.
2. Cable end not connected in drive unit.	2. Remove and reinstall drive unit.
3. Remote control damaged.	3. Repair or replace remote control.
4. Internal shift mechanism damage.	4. Repair or replace as necessary.

Drive Unit Jumps Out Of Gear

Cause	Remedy
1. Shift cables improperly adjusted.	1. Adjust shift cables.
2. Worn or damaged clutch and gears.	2. Repair.

Gear Housing Noise

Cause	Remedy
1. Metal particles in drive unit lubricant.	1. Disassemble, clean and inspect, and replace necessary components.
2. Propeller incorrectly installed.	2. Inspect mounting hardware. Install propeller correctly.
3. Propeller shaft bent.	3. Inspect and replace if necessary.
4. Incorrect gear shimming.	4. Check gear housing backlash and pinion gear height.
5. Worn or damaged gears and/or bearings caused by impact, overheating, or improper shimming.	5. Disassemble, inspect, replace.

Drive Shaft Housing Noise

Cause	Remedy
1. Steering lever contacting transom cutout opening in turns.	1. Modify transom cutout.
2. Engine flywheel housing contacting inner transom plate or exhaust pipe.	2. Determine cause for interference (loose engine mounts, transom too thin, etc.) and correct as necessary.
3. Propeller with untrue or out-of-balance blades.	3. Repair or replace, as required.
4. Abnormal sterndrive operation.	4. Instruct operator on proper operating technique.
5. U-joint cross and bearing assembly retaining rings improperly installed.	5. Make sure that proper thickness retaining rings are used and that rings are fully seated in u-joint bearing cap grooves.
6. Excessive side-to-side play in u-joint cross and bearing assemblies.	6. Replace cross and bearing assembly.
7. U-joint bearing caps contacting center socket or drive shaft housing bearing retainer.	7. Make sure proper cross and bearing assemblies are used. If interference is noted, replace center socket.
8. U-joint cross and bearings rough.	8. Disassemble cross and bearing assemblies and inspect. DO NOT RELY ON FEEL. Replace assemblies if they show signs of scoring, galling, roughness, lack of lubricant, etc.
9. O-rings missing or flattened out on u-joint shaft causing shaft to rattle against ID of gimbal bearing.	9. Install new o-rings.
10. Worn u-joint shaft splines and/or engine coupler splines.	10. Remove u-joint coupling end yoke and insert into gimbal bearing and engine coupling. Rotate shaft back-and-forth. If play is excessive, replace u-joint coupling end yoke and/or engine coupler, as necessary.
11. Engine alignment incorrect or engine coupler crooked.	11. Adjust alignment, making sure that alignment tool moves in-and-out of coupler freely. After proper alignment has been obtained, check for a cocked coupler by rotating engine coupler 1/2 turn and rechecking alignment. If proper alignment is no longer observed, coupler is crooked and must be replaced.

Drive Shaft Housing Noise (continued)

Cause	Remedy
12. Gimbal bearing rough.	12. Replace gimbal bearing. **IMPORTANT: Gimbal bearing and carrier MUST BE replaced as an assembly as they are a matched set. Failure to do this may result in a loose bearing fit in carrier.**
13. Loose gimbal bearing.	13. Reinstall bearing using a new tolerance ring if carrier is loose in gimbal housing. If bearing is loose in carrier, bearing assembly must be replaced.
14. Gimbal bearing not fully seated in gimbal housing. Yoke moves back and forth when turning and may hammer against bearing if not fully seated.	14. Drive bearing assembly into place. **IMPORTANT: Gimbal bearing must be pressed in past lead-in chamfer in bearing bore.**
15. Excessive clearance between gimbal ring and gimbal housing. This could cause misalignment between bell housing and gimbal housing, and also may allow gimbal ring to vibrate up-and-down, in turns.	15. Check and adjust clearance.
16. Improperly installed or failed rear engine mounts. This will affect engine alignment, but usually is not detectable with engine alignment tool.	16. Check for uneven mount height, or loose or soft mounts. Make sure there is clearance between flywheel housing and fiber washer. If no clearance exists, mounts have probably sagged. Install mounts correctly or replace, as necessary.
17. Boat transom too thin. **Thickness:** 2 in. (51 mm) minimum 2-1/4 in. (57 mm) maximum	17. Add thickness to transom.
18. Boat transom thickness uneven. This could affect engine to transom assembly alignment. It is usually not detectable with alignment tool. **Variation:** 1/8 in (3 mm) maximum	18. Repair boat as necessary.
19. Bell housing contacting gimbal ring. This would cause knocking in the fully trimmed IN position only.	19. Check for soft or split trim cylinder bushings, and loose or worn hinge pin bushings.

Drive Shaft Housing Noise (continued)

Cause	Remedy
20. Stringer height uneven or transom assembly installed crooked on boat transom. This will affect engine alignment, but is usually not detectable with alignment tool.	20. Measure the distance between the engine flywheel housing and the inner transom plate on both sides. If distances are uneven, the problem may be due to uneven stringer height or a cocked transom assembly. Adjust the stringer height or relocate the transom cutout as required.
21. Weak boat transom or boat bottom that flexes under power and causes engine misalignment - this condition will usually cause engine coupler failure.	21. This condition can sometimes be detected by having someone apply force to the top of the drive unit while watching the inner transom plate. If movement can be observed, the transom is weak and must be repaired.
22. Rear engine mount attaching hardware improperly installed or missing.	22. Reinstall hardware correctly.
23. Engine mounting holes drilled off-center in inner transom plate engine supports or engine flywheel housing	23. Make sure the holes are equally spaced fore and aft and are equal distance from the centerline.
24. Misalignment between bell housing, gimbal housing and engine coupler.	24. Contact your regional service center and arrange to have a technical service representative check the unit using a special gauge.

Performance Troubleshooting

Low Full-Throttle Engine RPM

Cause	Remedy
1. Improper drive unit trim angle.	1. Properly adjust drive unit trim angle.
2. Damaged propeller.	2. Repair or replace.
3. Improper propeller pitch.	3. Water test boat using a lower pitch propeller.
4. Dirty or damaged boat bottom.	4. Clean and/or resurface boat bottom.
5. Drive installation too low on transom.	5. Contact boat manufacturer for installation specifications.
6. Permanent “hook” in boat bottom. ***NOTE:*** *Some boats are built with a slight “hook” for correct boat performance.*	6. Check for a “hook” in the boat bottom by placing a straight edge, at least 6ft. (2m) long, under the bottom edge of the transom. If a “hook” is found, contact the boat manufacturer.

High Full-Throttle Engine RPM

Cause	Remedy
1. Improper propeller pitch.	1. Water test boat using a higher pitch propeller.
2. Propeller hub slipping.	2. Replace hub or replace propeller.
3. Drive installation too high on transom.	3. Contact boat manufacturer for installation specifications.
4. Engine coupler hub slipping.	4. Replace hub.

Propeller Ventilating/Cavitating

Cause	Remedy
1. Drive unit trimmed too high.	1. Trim drive unit IN/DOWN.
2. Incorrect propeller.	2. Install correct propeller.
3. Propeller hub slipping.	3. Replace hub.

Poor Boat Performance And/Or Poor Maneuverability-Bow Too Low

Cause	Remedy
1. Improper drive unit trim angle.	1. Properly adjust drive unit trim angle.
2. Boat is bow heavy.	2. Redistribute boat load to stern. If bow over weigh is caused by permanently installed fuel tank(s), etc., contact the boat manufacturer.
3. Boat is underpowered.	3. Check horsepower to weight ratio. Contact the boat manufacturer.
4. Permanent “hook” in boat bottom. ***NOTE:*** *Some boats are built with a slight “hook” for correct boat performance.*	4. Check for a “hook” in the boat bottom by placing a straight edge, at least 6ft. (2m) long, under the bottom edge of the transom. If a “hook” is found, contact the boat manufacturer.
5. Power hook or weak boat bottom.	5. Water test boat. Boat will perform normally until hook develops at high speed: then loss of RPM and speed will occur. Contact boat manufacturer.

Poor Boat Performance And/Or Poor Maneuverability-Bow Too High

Cause	Remedy
1. Improper drive unit trim angle.	1. Properly adjust drive unit trim angle.
2. Boat is stern heavy.	2. Redistribute boat load to bow. If stern overweight is caused by permanently installed fuel tank(s), etc., contact the boat manufacturer.
3. Propeller pitch too high.	3. Water test the boat using a lower pitch propeller.
4. Permanent “rocker” in boat bottom. ***NOTE:*** *Some boats are built with a slight “rocker” for correct boat performance.*	4. Check for a “rocker” in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under the bottom edge of the transom. If a “rocker” is found, contact the boat manufacturer.
5. Dirty boat bottom.	5. Clean boat bottom.

Steering System Troubleshooting

If Power Package is equipped with Power Steering, first determine if problem is caused by the Power Steering System or Ride Guide portion of the steering system.

Proceed as follows:

1. Remove clevis pin which attaches steering cable to Power Steering unit piston rod end clevis.
2. Remove clevis pin which secures piston rod end clevis to stern drive steering lever.
3. Turn steering wheel thru entire steering range. If steering difficulty is encountered problem is located in Ride Guide steering system.

If steering wheel turns with ease, problem is located in Power Steering system.

Hard Steering - Ride Guide Steering System

Cause	Remedy
1. Damaged steering cable.	1. Replace cable.
2. Steering cable too short (sharp bends) or too long (loops and long bends).	2. Select and install proper length cable.
3. Steering cable corroded or not lubricated.	3. Lubricate or replace the cable.
4. Ride Guide rack or rotary head not lubricated.	4. Disassemble and lubricate.

Hard Steering (Engine Running) Power Steering System

Cause	Remedy
1. Low power steering pump fluid level.	1. Check fluid level.
2. Loose power steering pump drive belt.	2. Adjust belt tension.
3. Air in system.	3. Locate source of air in lines or fittings. Correct and air bleed system.
4. Fluid leak.	4. Locate and correct source of leak.
5. If the above 4 steps do not solve the problem, test the power steering system.	5. Test power steering system.

Power Steering System External Fluid Leaks

Cause	Remedy
1. Pump reservoir leaking at fill cap (reservoir too full).	1. Remove fluid to bring to proper level.
2. Pump reservoir leaking at fill cap (air or water in fluid).	2. Locate source of air or water and correct. Air may enter because of low reservoir fluid level or internal pump leak. Test pump.
3. Loose hose connections.	3. Tighten hose connections.
4. Damaged hose.	4. Replace hose.
5. Bad cylinder piston rod seal.	5. Replace seal.
6. Damaged or worn control valve seals.	6. Replace seals.
7. Bad power steering pump seals and o-rings.	7. Repair pump.
8. Cracked or porous metal parts.	8. Replace part(s).

Power Trim Electrical System

Power Trim Pump Motor Will Not Run In The Out/Up Or In/Down Direction (Solenoids Do Not Click)

IMPORTANT: Refer to wiring diagram at end of this section for assistance in electrical system troubleshooting.

Cause	Remedy
1. Thermal circuit breaker in pump motor broken.	1. Replace commutator end plate assembly.
2. 20 amp fuse blown.	2. Determine cause for blown fuse and correct before replacing fuse ***NOTE:*** *If fuse blows while trimming "Out/Up" or raising drive unit, problem may be due to grounded trim limit switch leads. To check for grounded condition, disconnect trim limit switch leads at bullet connector "14," "15," "16," and "17" (in wiring diagram). If drive unit can now be raised (using "Trailer" switch), trim limit switch or leads are grounded.*
3. Power trim pump battery cables or wiring harness connections corroded or lose.	3. Clean and or tighten connections "1", "2," "4," "10," "11," "12," and "18," as necessary.
4. Trim control wiring harness connector loose or corroded.	4. Clean and secure connection "13" as necessary.
5. 110 amp fuse blown. ***NOTE:*** *Does not apply to an intermittent problem.*	5. Check for voltage at terminal "4." If no voltage is indicated, determine cause for blown fuse and correct, then replace fuse. Trimming OUT/UP and IN/DOWN simultaneously will blow fuse)
6. Open circuit in trim control wiring harness.	6. Check for battery voltage at terminal "8" while trimming OUT/UP and at terminal "6" while trimming IN/DOWN. If no voltage is indicated, check trim control for a loose or corroded connection or a damaged power supply lead in harness

Power Trim Pump Motor Will Not Run In The Out/Up Or In/Down Direction (Both Solenoids Click)

Cause	Remedy
1. Faulty solenoids or loose or corroded connections.	1. Check for battery voltage at terminal “5” (in wiring diagram) while trimming IN/DOWN and at terminal “3” while trimming OUT/UP. If no voltage is indicated check connections “2,” “3,” “4” and “5” and/or replace solenoids.
2. Pump motor brushes stuck, corroded or worn out.	2. Clean or replace, as required.
3. Armature commutator dirty.	3. Clean or replace armature, as required.
4. Armature faulty.	4. Test for shortened, open or grounded condition and replace if bad.
5. Field and frame faulty.	5. Check for open or grounded condition. Replace field and frame assembly, if bad.
6. Pump gears froze.	6. Replace pump valve body and gear assembly.
7. Power trim pump harness or trim control harness shortened	7. Disconnect blue-white lead from solenoid terminal “8.” If pump motor will now run in the IN/DOWN direction, a short in harness exists. Repair or replace harness, as necessary.

Power Trim Motor Runs In The Out/Up Direction, But Not In The In/Down Direction (In/Down Solenoid Does Not Click)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “6,” “7,” “8,” and “9” (in wiring diagram) and clean and/or tighten, as required.
2. Open IN/DOWN circuit in trim control or pump wiring harness.	2. Check for battery voltage at terminal “6” while trimming IN/DOWN. If no voltage is indicated, check for a loose or corroded IN/DOWN circuit connection, damaged IN/DOWN circuit lead or a faulty IN/DOWN trim switch. Repair or replace, as required
3. Solenoid faulty.	3. Replace solenoid.

Power Trim Motor Runs In The In/Down Direction, But Not In The Out/Up Direction - Both Trim And Trailer Switches Inoperative-(Out/Up Solenoid Does Not Click)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “8” and “9.” Clean and/or tighten as necessary.
2. Open OUT/UP circuit trim control or pump wiring harness.	2. Check for battery voltage at terminal “8” while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, blown fuse (if trim control is so equipped), damaged OUT/UP circuit lead, or a faulty OUT/UP trim switch. Repair or replace as necessary.
3. Solenoid faulty.	3. Replace solenoid.

Power Trim Pump Motor Runs In The Out/Up But Not In The In/Down Direction - In/Down Solenoid Clicks

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “4” and “5” (in wiring diagram) and clean and/or tighten, as required.
2. Faulty solenoid	2. Check for battery voltage at terminal “5” while trimming IN/DOWN. If no voltage is indicated, replace solenoid.
3. Faulty IN/DOWN field winding	3. Replace field and frame assembly.

Power Trim Pump Motor Runs In The In/Down Direction, But Not In The Out/Up Direction - Both Trim And Trailer Switches Inoperative - (Out/Up Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connection.	1. Check connections “2” and “3” (in wiring diagram). Clean and/or tighten, as necessary.
2. Open OUT/UP circuit in trim control or pump wiring harness.	2. Check for battery voltage at terminal “3” while trimming OUT/UP. If no voltage is indicated, replace solenoid.
3. Solenoid faulty	3. Replace solenoid.

Trim Control Out/Up Switch Inoperative (Trailer Switch Operates)

Cause	Remedy
1. Trim limit switch lead bullet connectors loose or corroded.	1. Clean and/or tighten connections “14,” “15,” “16” and “17” (in wiring diagram), as necessary.
2. Trim limit switch or leads faulty.	2. Disconnect trim limit switch leads from trim harness. Connect a continuity meter between leads “16” and “17.” Continuity should be indicated with drive unit in full IN/DOWN position. If not, check for damaged leads or poor connections. If this is not the cause, replace limit switch.
3. Open in trim control OUT/UP circuit	3. Check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or faulty OUT/UP trim switch. Repair or replace, as necessary.

Trim Control Trailer Switch Inoperative (Trim Out/Up Switch Functions)

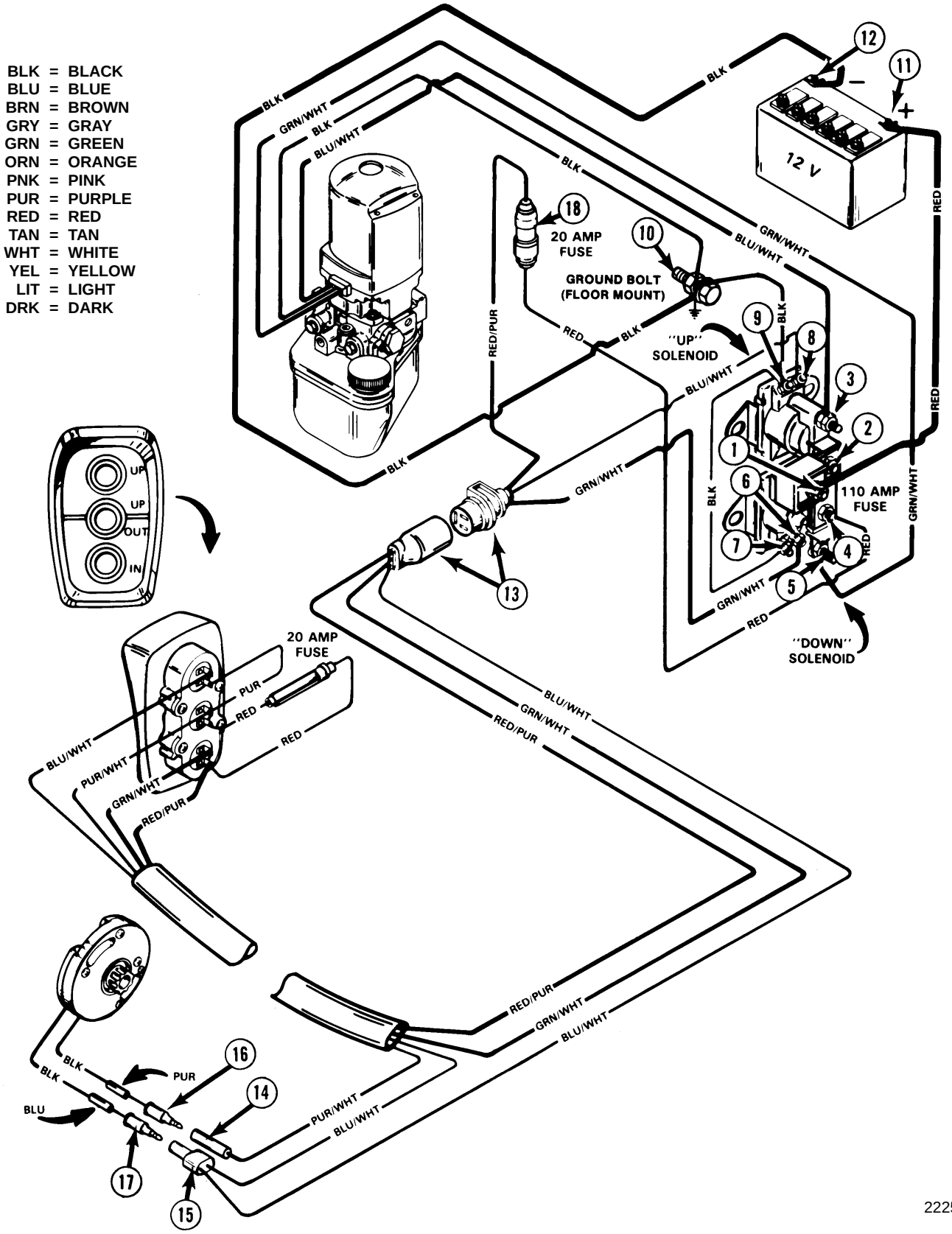
Cause	Remedy
Open trim control trailer circuit.	Check for a faulty trailer switch, loose or corroded connections, or damaged trailer circuit lead.

Trim System Functions While Unattended

Cause	Remedy
1. Faulty trim or trailer switch.	1. Replace switch.
2. Shorted trim pump harness or trim control harness.	2. Repair or replace as required.

Power Trim

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK



Wiring Diagram (With 3-Button Trim Control)

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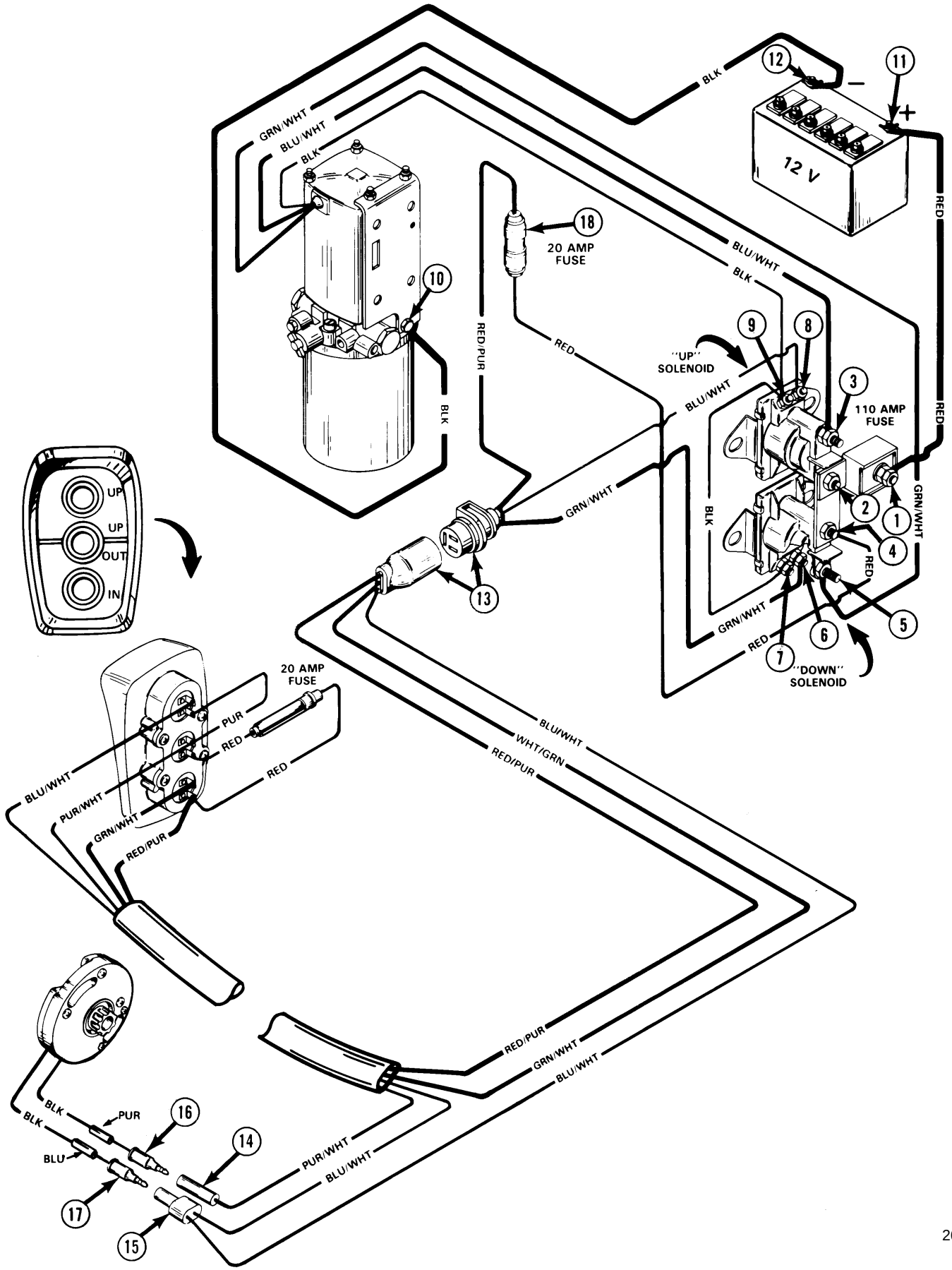

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Power Trim Electrical System Wiring Diagram (with 3-Button Trim Control)

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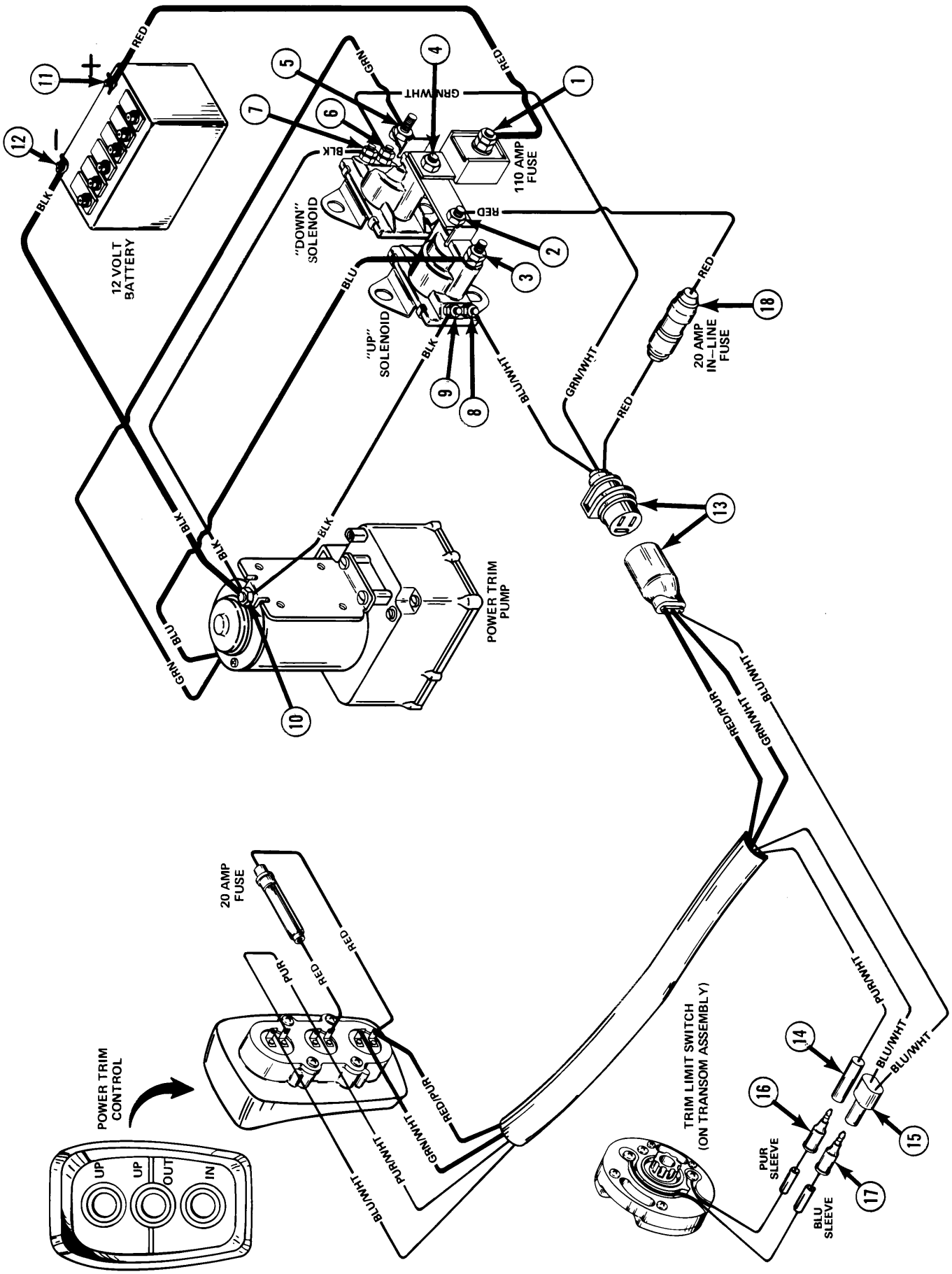
12 VOLT BATTERY
"DOWN" SOLENOID
"UP" SOLENOID
110 AMP FUSE
20 AMP IN-LINE FUSE
20 AMP FUSE
POWER TRIM PUMP
POWER TRIM CONTROL
UP
UP
OUT
IN
TRIM LIMIT SWITCH (ON TRANSOM ASSEMBLY)
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BLU SLEEVE
RED
BLK
BLU
GRN
GRN/WHT
BLU/WHT
RED/PUR
PUR/WHT
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Auto Trim Electrical System

NOTE: *Refer to wiring diagram, following, for assistance in electrical system troubleshooting.*

Pump Motor Will Not Run Up Or Down In Either Manual Or Auto Mode (Solenoids Click)

Cause	Remedy
1. Pump positive battery cable connection loose or corroded.	1. Check cable “14.”
2. 110 amp fuse blown or loose, or corroded solenoid connection.	2. Check for voltage at terminal “5.”
3. Pump motor brushes stuck, corroded or worn out.	3. Clean or replace.
4. Armature commutator dirty.	4. Clean or replace.
5. Armature faulty.	5. Test and replace if bad.
6. Field and frame faulty.	6. Test and replace if bad.
7. Pump gears frozen.	7. Replace pump adaptor.
8. Trim harness shorted between UP and DOWN circuit.	8. Disconnect blue-white lead “2” from solenoid terminal. If pump motor will now run in the DOWN direction, a short in the harness is indicated.

Pump Motor Will Not Run Up Or Down In Either Manual Or Auto Mode (Solenoids Do Not Click)

Cause	Remedy
1. Pump negative battery cable loose, corroded or damaged	1. Check cable “13” for a loose or corroded connection, or damage.
2. Mode switch wiring harness connector is loose at pump.	2. Secure connection “47.”
3. Faulty thermal circuit breaker in pump motor.	3. Connect a jumper wire between terminals “1” and “7.” If pump now operates, circuit breaker is faulty and field and frame assembly must be replaced.
4. Open circuit in mode switch wiring harness.	4. With ignition switch in “Run” position and mode switch in “Manual” mode, check for voltage at terminal “8” while trimming UP and terminal 12” while trimming DOWN. If no voltage is indicated, refer to items “5” and “6” immediately following.
5. No power to mode switch.	5. Check for voltage at terminal “25” (with ignition switch in “Run” position). If no voltage is indicated, check power lead for a poor connection.
6. Faulty mode switch.	6. Check for voltage at terminal “24” (with mode switch in “Auto” mode) and terminal “26” (with switch in the “Manual”mode). Replace switch if no voltage is indicated.

Pump Motor Will Run Up, But Not Down In Both Manual And Auto Modes (Down Solenoid Does Not Click)

Cause	Remedy
1. Loose or Dirty solenoid connections.	1. Check connections “4,” “7,” and “12.”
2. Faulty mode switch or open in DOWN circuit.	2. Check for voltage at terminal “12” while trimming DOWN (in “Manual” mode). If no voltage is indicated, repeat test at terminal “22” and “23.” If voltage exists at terminal “23,” but not at “22” switch is faulty. If voltage is present at terminal “22,” check leads “3” and “48” and connector “47” for an open condition.
3. Faulty DOWN solenoid.	3. Replace.

Pump Motor Will Run Up, But Not Down In Both Manual And Auto Modes (Down Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “10” and “11.”
2. Faulty solenoid.	2. Check for voltage at terminal “11” while trimming DOWN (in “Manual” mode). If no voltage is indicated, replace solenoid.
3. Faulty DOWN field winding.	3. Replace field and frame.

Pump Motor Runs Down, But Not Up In Both The Manual And Auto Modes (Up Solenoid Clicks)

Cause	Remedy
1. Loose or dirty solenoid connections.	1. Check connections “5” and “6.”
2. Faulty solenoid.	2. Check for voltage at terminal “6” while trimming UP. If no voltage is indicated, replace solenoid.
3. Faulty UP field winding.	3. Replace field and frame.

Pump Motor Runs Down, But Not Up In Both the Manual and Auto Mode - (Up Solenoid Does Not Click)

1. Faulty solenoid	1. Replace solenoid

Pump Motor Will Not Stop Running Down In Auto Mode (Trim Out/Up Switch And Trailer Switch Inoperative In Manual Mode)

NOTE: *An internal timer in the control module stops the pump motor 50 seconds after this condition occurs.*

Cause	Remedy
1. Loose or dirty solenoid connection.	1. Check connections “7” and “8.”
2. Faulty solenoid.	2. Check for voltage at terminal “8” while trimming UP (in Manual mode). If voltage exists, an open condition in solenoid is indicated and solenoid must be replaced. If no voltage is indicated, refer to steps 3 through 6 following.
3. Loose or corroded trim limit switch lead connections.	3. Check connections “32” and “36.”
4. Faulty trim limit switch.	4. Disconnect trim limit switch leads “32” and “36” and connect a continuity meter between leads. Continuity should exist with drive unit in DOWN position. If not, readjust or replace switch as necessary.
5. Open circuit in wiring harness.	5. Check leads “30,” “35,” “46,” and “2” for loose or corroded connections or physical damage.
6. Faulty control module.	6. Replace.

Pump Motor Will Not Run Up Or Down In Auto Mode (Manual Mode Functions Properly)

Cause	Remedy
1. Open in control module battery cables or wiring harness.	1. Check cables “16” and “18,” and lead “20.”
2. Faulty mode switch.	2. Check for voltage at terminal “24” and “25” with switch in Auto mode. If voltage exists at terminal “25,” but not “24,” switch is faulty.
3. Faulty control module.	3. Replace.

Pump Motor Will Run Down, But Not Up In Auto Mode (Manual Mode Functions Properly)

1. Open circuit in control module sense lead.	1. Check lead “17” (in Figure 12) for loose or corroded connections or damage.
2. Faulty control module.	2. Replace.

Pump Motor Will Run Up, But Not Down In Auto Mode (Manual Mode Functions Properly)

Cause	Remedy
1. Faulty mode switch.	1. Check for voltage at terminal “21” and “22” while turning ignition switch to “Run” position (in “auto” mode). If voltage exists at “21”, but not at “22”, switch is faulty.
2. Open circuit in wiring.	2. Check lead “19” for a loose or corroded connection or damage.
3. Faulty control module.	3. Replace.

Trim System Completely Inoperative In Manual Mode (Auto Mode Functions Properly)

Cause	Remedy
1. Faulty mode switch.	1. Check for voltage at terminal “26” with mode switch in “Manual” mode. If no voltage is indicated, replace switch.
2. Open circuit wiring harness.	2. Check leads “27” and “33” for loose or corroded connections or damage.

Trim In/Down Switch Inoperative In Manual Trim Control - Trim Out/Up Switch and Trailer Switch Function (Auto Mode Functions Properly)

Cause	Remedy
1. Faulty IN/DOWN switch in manual trim control.	1. Check for voltage at terminal “38” while trimming IN/DOWN (in “Manual” mode). If no voltage is indicated, switch is faulty.
2. Open circuit in wiring harness.	2. Check for voltage at terminal “23” while trimming IN/DOWN. If no voltage is present, check leads “28” and “34” for a loose or corroded connection or damage.
3. Faulty mode switch.	3. Check for voltage at terminal “22” while trimming IN/DOWN. If no voltage exists, switch is faulty.

Trim Out/Up Switch And Trailer Switch Inoperative In Manual Trim Control - Trim In/Down Switch Operates (Auto Mode Functions Properly)

Cause	Remedy
1. Trim control 20 amp fuse (if so equipped) - “43” blown.	1. Determine cause for blown fuse and correct before replacing fuse.
2. Open in power supply lead to trim and trailer switch.	2. Check voltage at terminal “44.” If no voltage is indicated, check lead “45” for a poor connection or damage.
3. Faulty trim OUT/UP switch (applies only to trim controls where it is necessary to actuate trim UP switch in order for trailer switch to function).	3. Check for voltage at terminal “40” while actuating trim OUT/UP switch. Replace switch if no voltage is indicated.

Trim Out/Up Switch Inoperative In Manual Trim Control - Trailer Switch Operates Properly (Auto Mode Functions Correctly)

Cause	Remedy
1. Faulty trim OUT/UP switch (applies only to trim controls where it is not necessary to actuate trim UP switch in order for trailer switch to function - not shown).	1. While actuating switch, check for voltage at output terminal. Replace switch if voltage is not indicated.
2. Open circuit in wiring harness	2. Check leads “31” and “37” for loose or corroded connections or damage.
3. Faulty control module.	3. Replace.

Trailer Switch Inoperative In Manual Trim Control - Trim Out/Up Switch Functions

Cause	Remedy
1. Faulty trailer switch.	1. Check for voltage at terminal “41” and “42” while actuating trailer switch. If voltage exists at terminal “42,” but not at terminal “41,” a faulty switch is indicated. If no voltage exists at terminal “42,” check power supply lead for an open.
2. Open in wiring.	2. Check lead “39” for a loose or corroded connection or damage.

Boat Is On Plane Well Before Drive Unit Begins To Trim Out

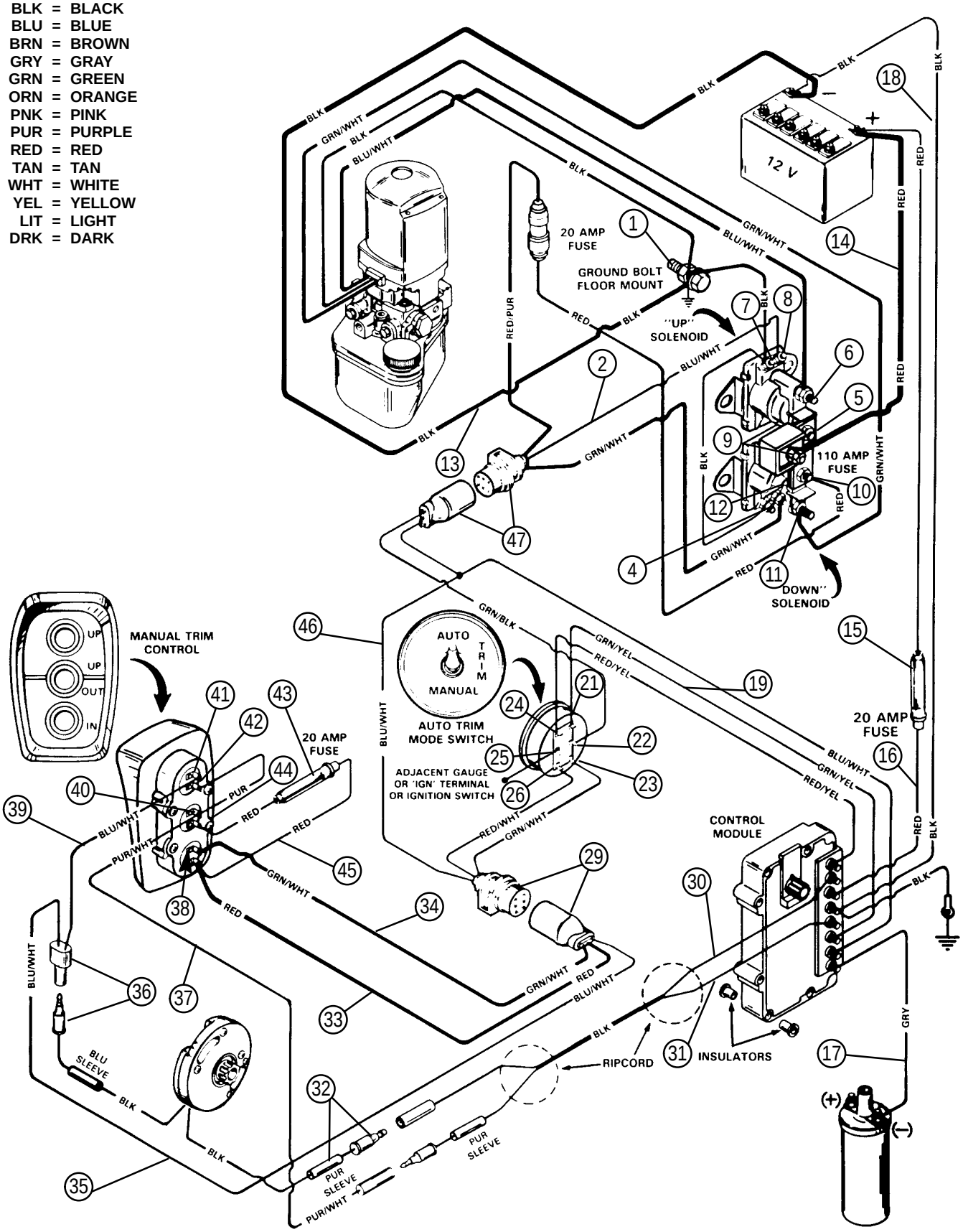
Cause	Remedy
1. Control module adjustment incorrect.	1. Refer to SECTION 5 for adjustment procedure.
2. Faulty control module.	2. Replace control module.

Boat Is Not On Plane Before Drive Unit Begins To Plane Out

Cause	Remedy
1. Control module adjustment incorrect.	1. Refer to SECTION 5 for adjustment.
2. Faulty control module.	2. Replace control module.

Auto Trim II System Wiring Diagram

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK



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Power Trim System Troubleshooting - Hydraulic System on Oildyne Trim Pump

NOTE: *The callouts (eg. "5") in the Hydraulic System troubleshooting section refer to the hydraulic schematic on page 1C - 31.*

Drive Unit Cannot Be Trimmed Out/Up, Trims Slowly Or Trims With Jerky Movements

Cause	Remedy
1. Power Trim pump oil level low.	1. Check for cause of low oil level and correct. Add oil and bleed trim system.
2. Air in trim system.	2. Check for cause of entry and correct. Add oil to pump and bleed air from system.
3. O-rings damaged on Manual Release Valve (if equipped) or valve not completely closed.	3. Replace valve and/or close completely.
4. Insufficient pump pressure or pump shuttle valve stuck.	4. Test (as explained in "Testing Power Trim Pump", (Sec 5A). If shuttle "1" is stuck, replace pump adaptor (Sec 5A). If pressure is low, replace adaptor or attempt to repair by replacing the following components: • OUT/UP pressure relief valve • Thermal relief valve
5. Hoses reversed on one cylinder only.	5. Connect hoses "7" and "8" correctly.
6. Trim cylinder(s) binding.	6. Check for cause of binding (bent piston rod, scored cylinder, etc.). Repair or replace as necessary.
7. Gimbal housing-to-trim pump hydraulic hose pinched.	7. Replace hose "7."
8. Up pressure relief valve has dirt particles under check ball.	8. Replace with a new valve kit.
9. Relief balls stuck in the up side of the pump assembly**.**	9. Replace the pump assembly in the adapter.
10. Dirt or foreign material under the up pressure relief valve.	10. Replace the up pressure relief valve assembly.
11. Check the condition of the oil, it may be contaminated and thick like honey.	11. Remove the reservoir and clean out the contaminated oil.
12. A possible tight adaptor pump gear, or water or oil in the motor.	12. Replace the pump assembly in the adaptor, or replace the electric motor assembly.

Drive Unit Cannot Be Lowered From Up Position Or Lowers With Jerky Movements

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed trim system.
2. Low oil level.	2. Add oil.
3. Damaged O-rings on manual release valve (if equipped).	3. Replace valve.
4. Insufficient IN/DOWN pressure or shuttle “1” valve stuck.	4. Test (as explained in “Testing Power Trim Pump”, Sec 5A). If shuttle “1” is stuck, replace pump adaptor. (Sec 5A) If pressure is low, replace adaptor or attempt to repair by replacing the following item: ● IN/DOWN pressure relief valve “6.”
5. Trim cylinder(s) block leaking internally.	5. Test. Rebuild or replace cylinder as necessary.
6. Trim cylinder(s) “5” binding.	6. Check for cause of binding. Repair or replace as necessary.
7. Gimbal housing-to-trim pump hydraulic hose “8” or “7” pinched.	7. Replace hose “8” or “7.”
8. Hoses “10” and “11” reversed on one trim cylinder only.	8. Reconnect hoses “10” and “11” correctly.
9. Drive unit binding in gimbal ring.	9. Check for cause of binding and replace.
10. Down Pressure relief valve “6” has dirt particles under check ball.	10. Replace with a new valve kit.
11. Foreign material under down pressure relief valve.	11. Replace the down pressure relief valve assembly
12. Dirt or foreign material under the down pressure relief valve	12. Replace the down pressure relief valve assembly
13. Check the condition of the oil, it may be contaminated and thick like honey	13. Remove the reservoir and clean out the contaminated oil
14. A possible tight adaptor pump gear, or water or oil in the motor	14. Replace the pump assembly in the adaptor, or replace the electric motor assembly

Drive Unit Will Not Stay In Full Up Position For Extended Periods

Cause	Remedy
1. External leakage.	1. Check for cause and correct. Add oil to pump and bleed trim system.
2. Damaged o-ring on manual release valve (if so equipped) or valve not closed completely.	2. Replace valve and/or close completely.
3. Pump OUT/UP circuit leaking internally.	3. Test. Replace adaptor “2” or attempt to repair by replacing the following: ● Thermal relief valve “4” ● Pilot check valve or seals “9”
4. Trim cylinder(s) leaking internally and pump DOWN circuit leaking internally (both must be faulty to cause this problem).	4. Rebuild cylinders “5.” Repair or replace adaptor “2” as required.
5. Either Foreign Material under the poppet valve seat or a bad rubber seat on the face of the poppet valve.	5. Install an Overhaul Kit.

Drive Will Not Stay In The Trimmed Out/Up Position When Underway

NOTE: *Use the following in conjunction with items mentioned under “Drive Unit Will Not Stay In Full ‘Up’ Position For Extended Periods”*

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed system.
2. Leaky shuttle poppet valve “1.”	2. Install repair kit for shuttle valve “1.”

Drive Unit Trails Out/Up On Deceleration Or When Shifting Into Reverse (Unit Thumps When Shifting)

Cause	Remedy
1. Trim cylinders(s) leaking internally.	1. Test. Rebuild or replace cylinders as necessary.
2. Trim pump IN/DOWN circuit leaking internally.	2. Test. Replace adaptor or attempt to repair by replacing the following: ● Pilot check valves or seals “9” ● Install trim pump rebuild kit

Oil Foams Out Of Pump Fill/Vent Screw

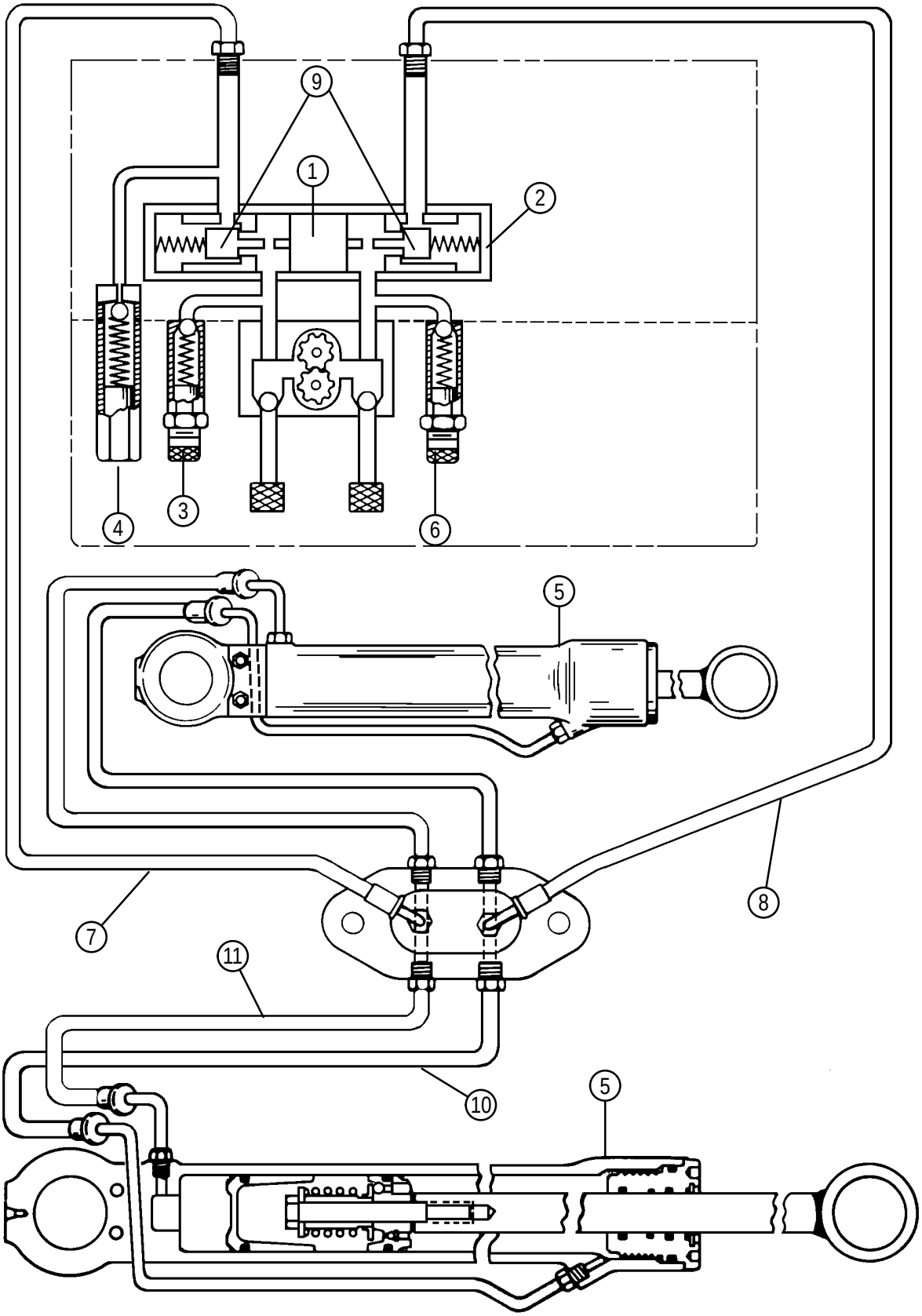
Cause	Remedy
1. Contaminated oil.	1. Flush system with clean oil refill pump and bleed trim system.
2. Oil level low.	2. Check for cause of low oil level and correct. Add oil to pump and bleed system.

The Trim Pump Motor Runs But Does Not Pump Oil

Cause	Remedy
1. Broken coupler between the pump and the motor.	1. Replace the coupler.

Power Trim Hydraulic Schematic

1 - Shuttle
2 - Pump Adaptor
3 - Out/Up Pressure Relief Valve
4 - Thermal Relief Valve
5 - Trim Cylinder
6 - IN/DOWN Pressure Relief Valve
7 - Out/Up Hose
8 - IN/DOWN Hose
9 - Pilot Check Valves
10 Gimbal Ring to Trim Cylinder IN/DOWN Hose
11 Gimbal Ring to Trim Cylinder OUT/UP Hose



Power Trim System Troubleshooting - Hydraulic System on Prestolite Trim Pump

Drive Unit Cannot Be Trimmed OUT/UP Or Trims Slowly Or with Jerky Movements

(Numbers refer to callouts on the Oildyne Trim System Diagram P. 1C-21)

Cause	Remedy
1. Power trim pump oil level low (1).	1. Check for cause of low oil level and correct. Add oil.
2. Air in trim system.	2. Check for cause of entry and correct. Add oil to pump and bleed trim system.
3. Manual release valve (2) not completely closed.	3. Close valve (2) completely.
4. Insufficient pump pressure or pump shuttle valve (3) stuck.	4. Test, as explained following. Replace valve body and gear assembly.
5. Hoses (5) (6) reversed on one cylinder only.	5. Connect hoses (5) (6) correctly.
6. Trim cylinder(s) (7) binding.	6. Check for cause of binding (bent piston rod (8), etc.). Repair or replace, as necessary.
7. Gimbal housing-to-trim pump hydraulic hoses (4) (9) pinched.	7. Replace hose (4) (9).

Drive Unit Cannot Be Lowered From OUT/UP Position or Lowers with Jerky Movements

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed trim system.
2. Insufficient pump IN/DOWN pressure or shuttle valve (3) stuck.	2. Test, as explained following. Replace valve body and gear assembly.
3. Trim cylinder(s) (7) leaking internally.	3. Test, as explained following. Rebuild or replace cylinder (7) as necessary.
4. Trim cylinder(s) (7) binding.	4. Check for cause of binding (bent piston rod (8), etc.). Repair or replace, as necessary.
5. Gimbal housing-to-trim pump hydraulic hose (4) (9) pinched.	5. Replace hoses (4) (9).
6. Hoses (5) (6) reversed on one trim cylinder only.	6. Reconnect hoses (5) (6) correctly.
7. Drive unit binding in gimbal ring.	7. Check for cause of binding (bent gimbal ring, drive shaft housing, etc.) and replace.

Drive Unit Will Not Stay In Full OUT/UP Position For Extended Periods

Cause	Remedy
1. External leakage.	1. Check for cause and correct. Add oil to pump (1) and bleed trim system.
2. Pump OUT/UP circuit (3) (4) (5) leaking internally.	2. Test as explained following. Replace valve body and gear assembly. Also check trim cylinders (7) for internal leakage.

Drive Unit Will Not Stay In Trimmed OUT/UP Position When Underway

Cause	Remedy
1. Air in trim system.	1. Check for cause of entry. Fill and bleed system.
2. External leakage.	2. Check for cause and correct. Add oil to pump and bleed trim system.
3. Pump OUT/UP circuit leaking internally (3) (4) (5).	3. Test as explained following. Replace valve body and gear assembly.

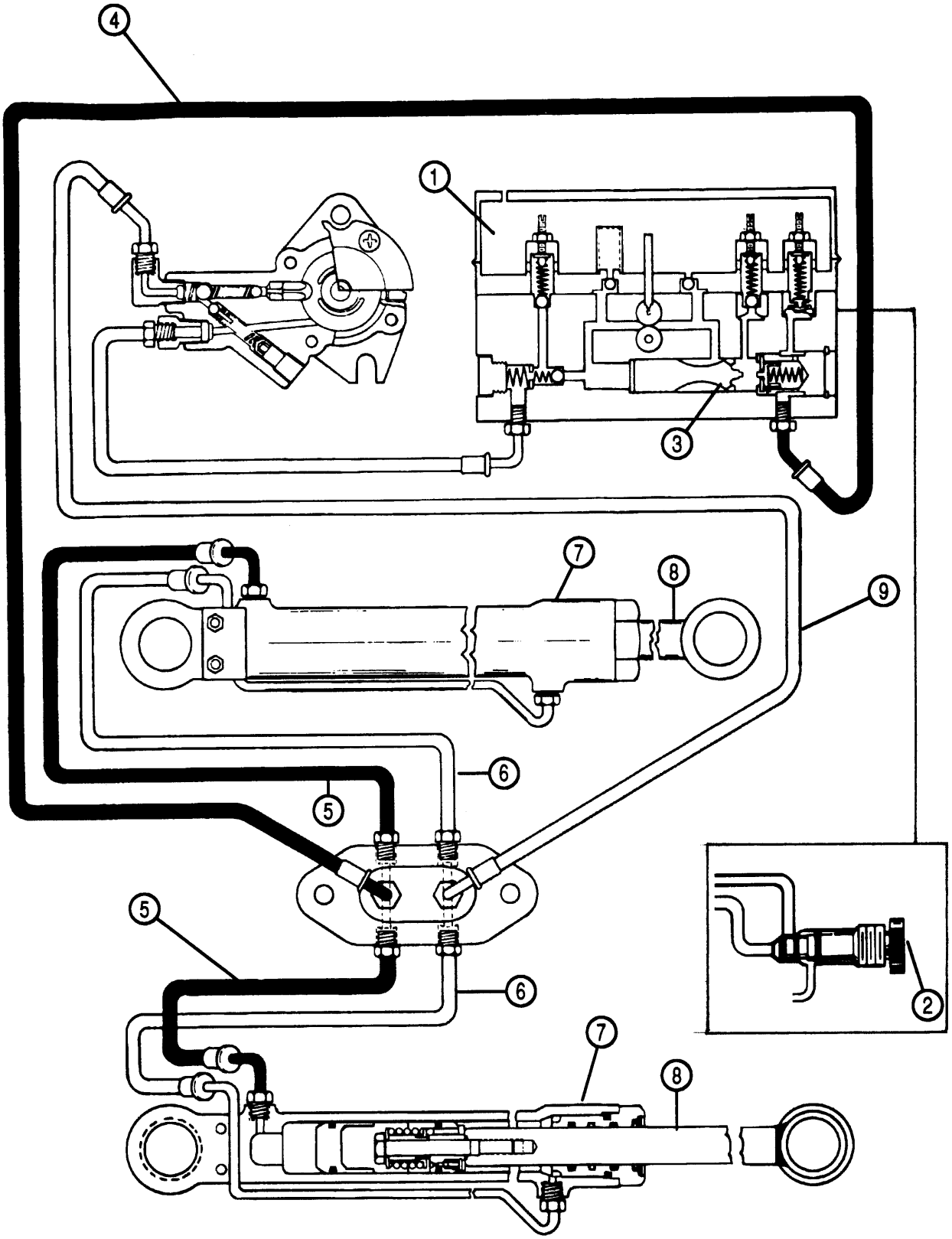
Drive Unit Trails OUT/UP on Deceleration or When Shifting into Reverse (Unit Thumps When Shifting)

Cause	Remedy
1. Air in trim system.	1. Determine cause for air entry and correct. Add oil to pump and bleed trim system.
2. Trim cylinder(s) (7) leaking internally.	2. Test as explained following. Replace or rebuild cylinder(s) (7), as necessary.
3. Trim pump IN/DOWN circuit (3) (6) (9) leaking internally.	3. Test as explained following.

Oil Foams Out of Pump “Vent” Screw

Cause	Remedy
1. Contaminated oil.	1. Flush system with clean oil, refill pump and bleed trim system.
2. Oil level low.	2. Check for cause of low oil level and correct. Add oil to pump (1) and bleed system.

Prestolite Trim System Diagram



Corrosion Protection

Corrosion Of Underwater Parts, Without Mercathode Or Current Protection

Cause	Remedy
1. Sacrificial anode(s) consumed.	1. Replace anode(s) when 50% consumed.
2. Stainless steel propeller installed.	2. Add Mercathode (impressed current protection) or additional sacrificial anodes.
3. Sacrificial anode(s) not grounded to drive.	3. Remove anode(s), clean contact surface, reinstall, check continuity.
4. Loss of continuity between underwater parts & ground.	4. Provide good ground connections.
5. Shore power causing overload of anode(s) and/ or Mercathode.	5. Disconnect shore power or install Quicksilver isolator.
6. Paint on drive heavily abraded (exposed metal).	6. Prime and repaint, and/or install additional anode(s).
7. Sacrificial anode(s) painted.	7. Remove paint or replace anode(s).
8. Drive tilted so far that anode(s) are out of the water.	8. Leave drive down, install additional anode (below water line), or transom mount a Mercathode.
9. Only power trim cylinders corroded.	9. Provide good ground to drive. All parts must be grounded.
10. Corrosion in area of exhaust outlets (exhaust deposits can cause corrosion).	10. Remove deposits with marine or auto wax.
11. Corrosion occurring after unit removed from saltwater.	11. Wash exterior and flush interior with fresh water.

Corrosion On Underwater Parts, With Mercathode Or Current Protection (Drive Corroding)

Cause	Remedy
1. Poor connection between reference electrode (brown) lead or anode (orange) lead and Mercathode controller.	1. Clean and/or tighten connection. Repair wiring.

Corrosion On Underwater Parts, With Mercathode Or Impressed Current Protection (Drive Corroding) (Continued)

2. Faulty Mercathode reference electrode.	2. Disconnect reference electrode lead (brown) from the controller “R” terminal. Connect the lead to positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect negative (-) meter lead to negative (-) battery terminal. Note meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
3. Faulty Mercathode controller.	3. With anode and reference electrode leads connected to controller, connect a jumper wire between “R” and “-” terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to “A” terminal on controller. Connect the negative (-) meter lead to the negative (-) controller terminal. Reading should be as follows: ● Freshwater Areas = 11.5 volts minimum ● Seawater Areas = 3.55 volts minimum If the reading is low, replace the controller.
4. Too much cathode (such as stainless steel).	4. Mercathode system overpowered by large quantity of stainless steel below the water line.
5. Loss of continuity between drive components and ground.	5. Ensure continuity (check continuity wires and washers).
6. Sacrificial anodes consumed, painted, or inoperative.	6. Replace anodes.
7. Mercathode reference electrode or anode painted.	7. Remove paint or replace anode or Mercathode reference electrode.
8. No power to Mercathode controller.	8. Connect positive (+) lead of volt meter (set on 0-20 volt scale) to positive (+) terminal on the controller and negative (-) volt meter lead to negative (-) terminal. Meter should indicate battery voltage. Check for blown fuse (if so equipped) on a standard Mercathode system. Clean the connection or repair wiring as required.
9. Mercathode system not functioning.	9. a. Check the fuse in the hot lead. b. Check battery. c. Check for loose connections at controller and battery. d. Check the grounding wire between the drive and the controller.

Corrosion On Underwater Parts, With Mercathode Or Impressed Current Protection (Drive Overprotected)

Cause	Remedy
1. Faulty Mercathode reference electrode.	1. Disconnect reference electrode lead (brown) from “R” terminal on controller. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
2. Faulty Mercathode controller.	2. a. Check controller output. If the hull potential indicates overprotection, remove the reference electrode lead from the controller. if the controller is off (no impressed current called for) the voltage between the negative (black) and the anode should be less than 1 volt. If your digital voltmeter can measure amperage; with the reference electrode disconnected, the amperage between the negative on the controller and the anode terminal should be less than 1 milliamp. b. Replace the controller.
3. Stray current corrosion (electrical current leaves a metal conductor and creates a path through the water).	3. Disconnect electrical components one at a time and observe the multimeter reading until you eliminate the high reading (see Troubleshooting Procedures). Correct the source of the stray current.
4. Poor connection between the Mercathode reference electrode lead (brown) and the “R” terminal on the controller.	4. Clean and/or tighten the connection. Repair wiring as needed.
5. Mercathode system not functioning.	5. a. Check the fuse in the hot lead. b. Check battery. c. Check for loose connections at controller and battery. d. Check the grounding wire between the drive and the controller.

Corrosion Troubleshooting Procedures

1. Unplug shore power (if equipped).
2. Measure hull potential with silver/silver chloride reference electrode and digital volt/ohm meter.

READINGS

	Potential	Diagnosis1
Saltwater	Below 850 millivolts	Drive is corroding, see **(DRIVE CORRODING)**, p. 1C - 35
	Between 850 - 1100 millivolts	Drive is protected
	Above 1100 millivolts	Drive is overprotected, see **(DRIVE OVERPROTECTED)** p. 1C - 37

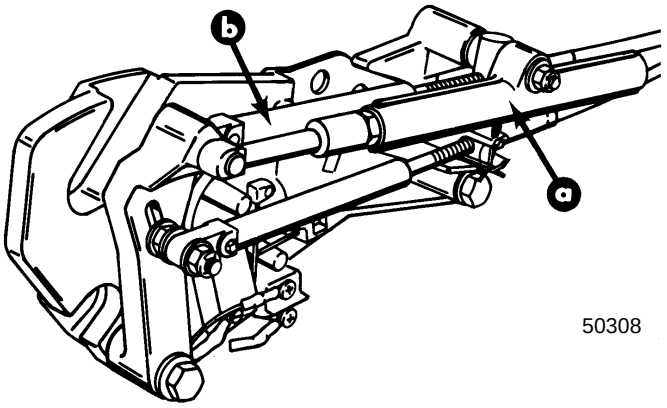
	Potential	Diagnosis
Freshwater	Below 750 millivolts	Drive is corroding, see **(DRIVE CORRODING)**, p. 1C - 35
	Between 750 - 1050 millivolts	Drive is protected
	Above 1050 millivolts	Drive is overprotected, see **(DRIVE OVERPROTECTED)** p. 1C - 37

CORROSION SYMPTOMS

- Paint blistering (usually on sharp edges)
- Loosely adhering white corrosion products on exposed aluminum surfaces (do not confuse these with tenaciously clinging calcium carbonate deposits)
- Aluminum pitting

Shift System Troubleshooting

NOTE: *Some models may be equipped with a shift assist assembly. The only difference with these models is that the remote control shift cable attaching hardware is slightly longer. Shift cable adjustment is the same as all other versions.*



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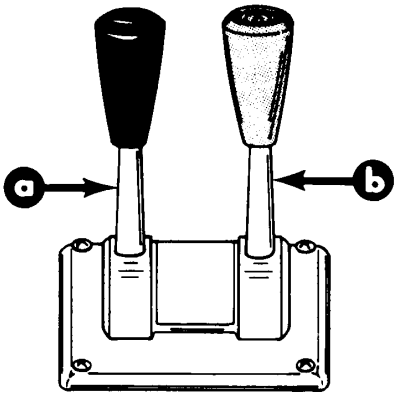
a - Shift Assist Assembly
b - Remote Control Shift Cable

IMPORTANT: If boat is equipped with A REMOTE CONTROL THAT HAS SEPARATE SHIFT AND THROTTLE LEVERS, this shift assist assembly should NOT be used. The use of the shift assist assembly with this type of remote control can cause the shift lever to move out of gear unexpectedly.



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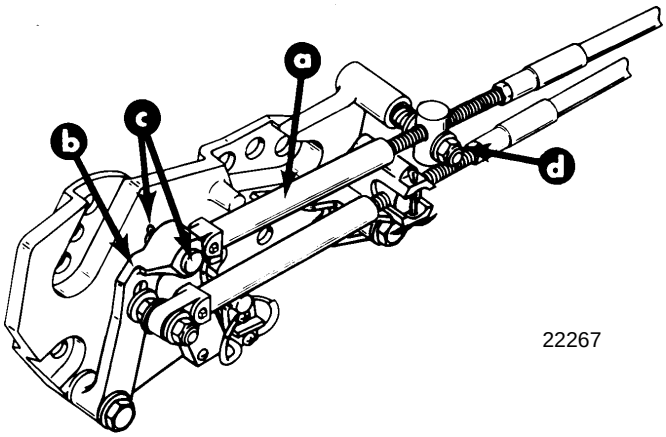
a - Shift Lever
b - Throttle Lever

Checking for Excessive Play

Checking the drive unit for excessive play in shift system can be done with the boat in the water or on land. Refer to appropriate procedure following:

Boat Out of Water (Engine Off)

1. Disconnect remote control shift cable.



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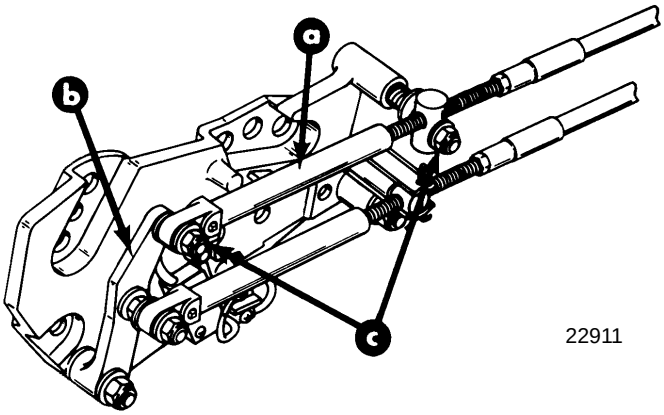
Later Models (With Plastic Shift Lever)

a - Remote Control Shift Cable
b - Plastic Shift Lever
c - Clevis Pin and Cotter Pin
d - Locknut and Washer



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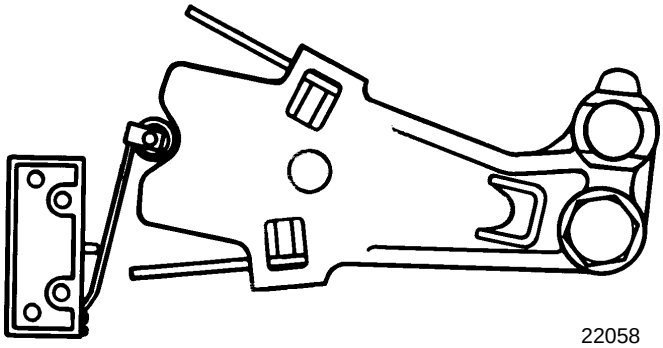
Earlier Models (With Metal Shift Lever)

a - Remote Control Shaft Cable
b - Metal Shift Lever
c - Locknuts and Washers

IMPORTANT: When pushing or pulling on drive unit shift cable in the following steps, apply enough pressure so that shift cutout switch roller starts to move off center of notch, then ease up slightly. Use a fine tip marking device to mark threaded tube to obtain an accurate measurement.



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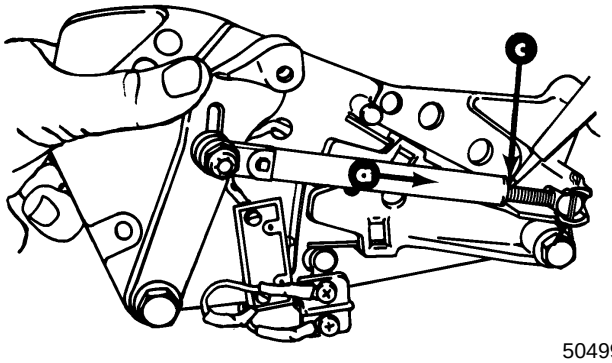
a - Shift Cutout Switch Roller

2. Check for excessive play in drive unit shift system as follows:
   a. Place drive unit into gear by pushing in on drive unit shift cable, while simultaneously rotating propeller shaft counterclockwise until shaft stops, to ensure full clutch engagement.
   b. Place a mark on shift cable threaded tube against edge of end guide.



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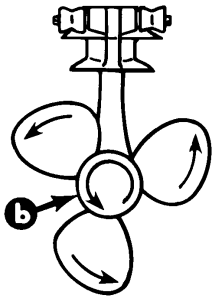

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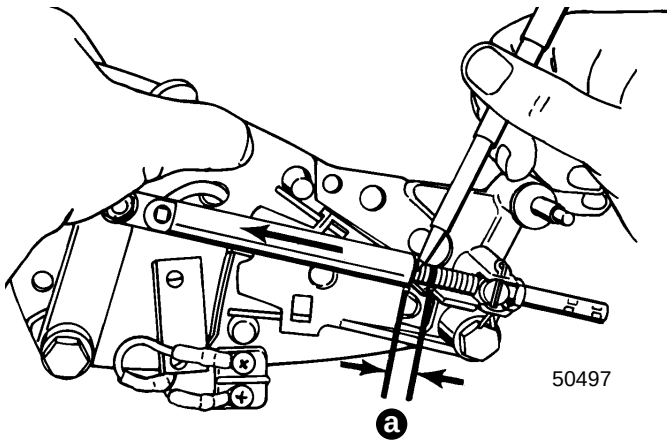
a - Drive Unit Shift Cable
b - Propeller Shaft
c - Threaded Tube

   c. While maintaining pressure on propeller shaft in a counterclockwise direction (to keep clutch locked with gear), lightly pull out on shift cable end guide and place another mark on threaded tube.
   d. Measure distance between both marks. Distance should be **9/16 in. (14 mm) or less.**



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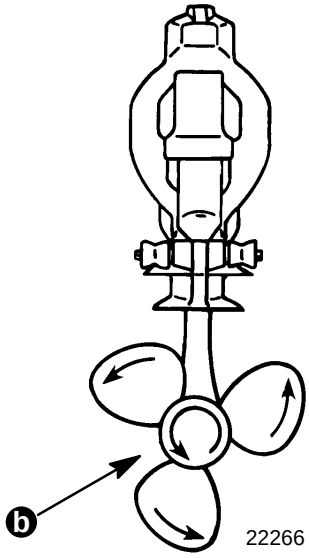


22266

a - 9/16 in. (14 mm) or Less
b - Propeller Shaft

If play is 9/16 in. (14 mm) or less: No further attention to drive unit is needed. Proceed with adjustments.

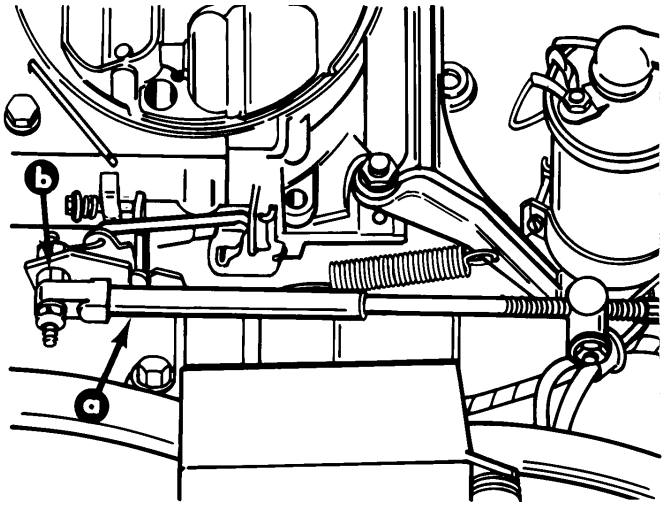
If play is more than 9/16 in. (14 mm): Drive unit must be removed to further isolate excessive play.

Boat In Water (Engine Running)

⚠ WARNING

- **At least two people will be needed for the following procedure, one person to check the adjustment and one person to stay at the control station of the boat.**
- **Ensure boat is secured to dock and precautions have been taken to avoid damage to boat prior to placing drive unit into gear.**

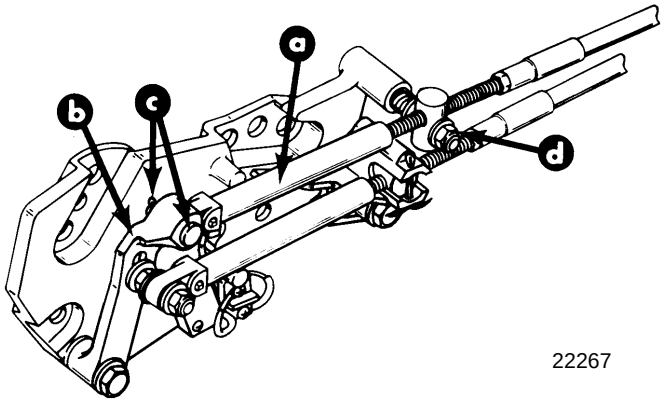
1. Start engine and let it warm up (Refer to operating procedures in Operation and Maintenance Manual).
2. Disconnect throttle cable(s) from carburetor(s).



22062

a - Throttle Cable End Guide
b - Carburetor Throttle Lever

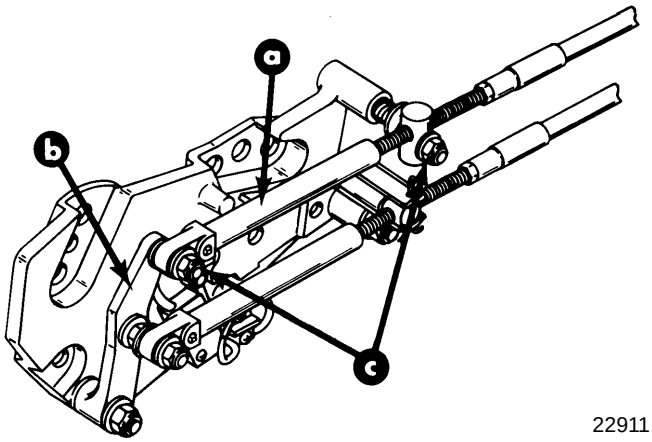
3. Disconnect remote control shift cable.



22267

Later Models (With Plastic Shift Lever)

a - Remote Control Shift Cable
b - Plastic Shift Lever
c - Clevis Pin and Cotter Pin
d - Locknut and Washer

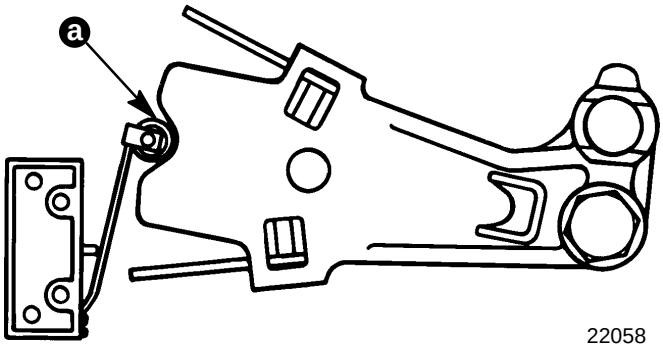


22911

Earlier Models (With Metal Shift Lever)

a - Remote Control Shaft Cable
b - Metal Shift Lever
c - Locknuts and Washers

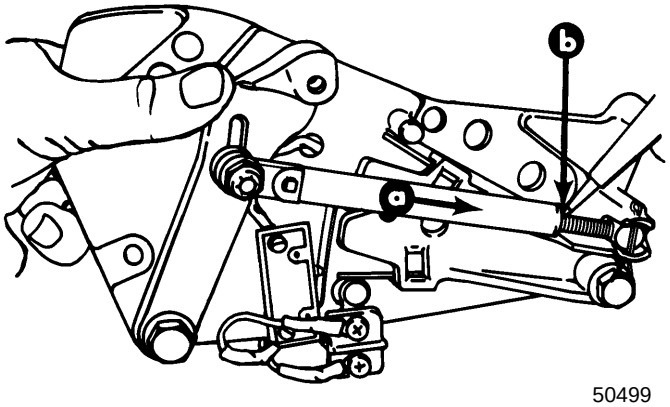
IMPORTANT: When pushing or pulling on drive unit shift cable, in the following steps, apply just enough pressure so that shift cutout switch roller just starts to move off center of notch; then, ease up slightly. Use a fine tip marking device to mark threaded tube to obtain an accurate measurement.



22058

a - Shift Cutout Switch Roller

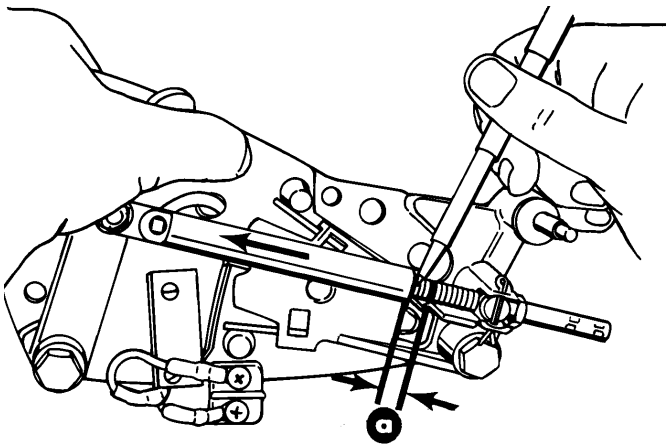
4. Check for excessive play in drive unit shift system as follows:
   a. Push in on drive unit shift cable.
   b. Place a mark on shift cable threaded tube, against cable end guide.



50499

a - Drive Unit Shaft Cable
b - Threaded Tube

   c. Lightly pull on drive unit shift cable end guide and place another mark on threaded tube.
   d. Measure distance between both marks. Distance should be **9/16 in. (14 mm) or less.**



50497

a - 9/16 in. (14 mm) Or Less

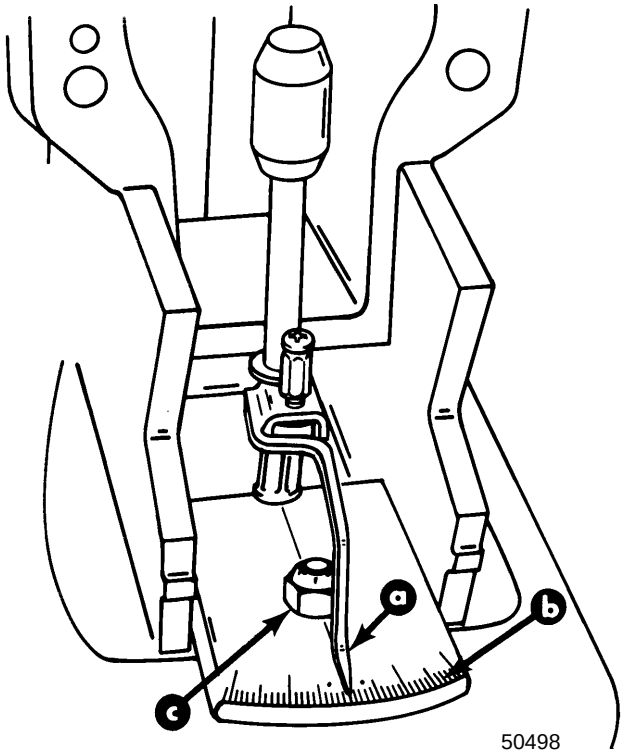
If play is 9/16 in. (14 mm) or less: No further attention to drive unit is needed. Proceed with adjustments.

If play is more than 9/16 in. (14 mm): Drive unit must be removed to further isolate excessive play.

Isolating Excessive Play

NOTE: *Refer to the end of this section for templates and patterns needed to fabricate similar tools.*

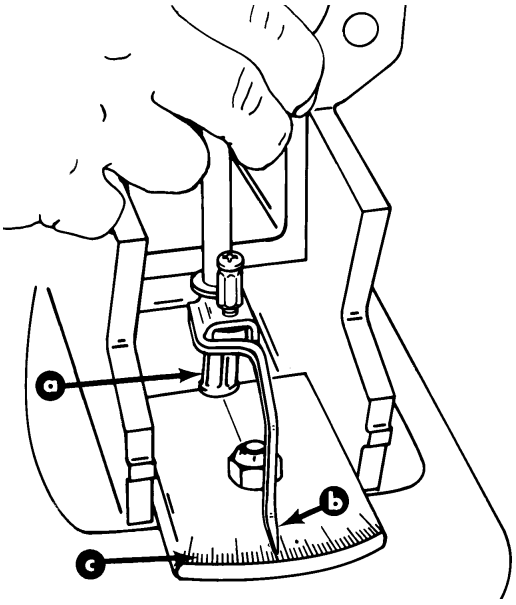
1. To determine shift shaft rotational end play, use a tool such as the one shown to measure degrees of play in shift shaft with clutch locked and held in gear.
   a. Install tool as shown.



50498

a - Pointer - Installed on Shift Shaft
b - Scale (1° Increments)
c - Nut

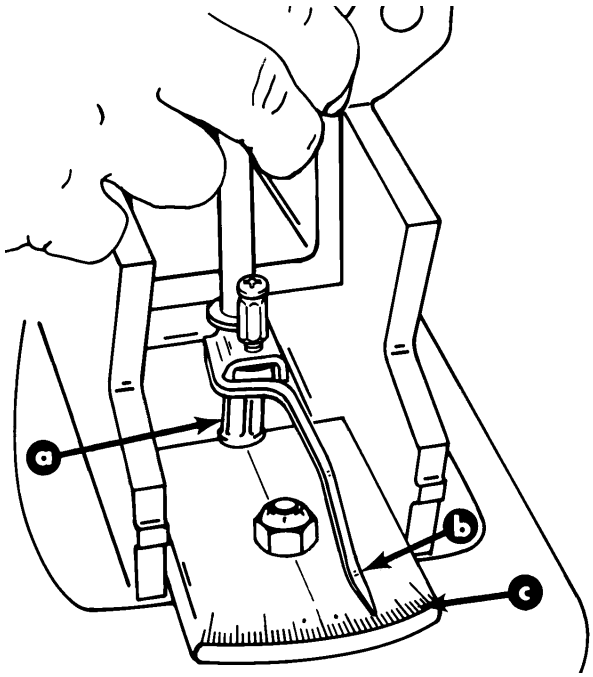
b. Rotate shift shaft coupler clockwise while simultaneously turning propeller shaft counterclockwise until clutch locks into gear. Make note of pointer location on scale.



50498

a - Shift Shaft Coupler
b - Pointer
c - Scale

c. While maintaining pressure on propeller shaft to keep clutch locked with gear, lightly turn shift shaft coupler counterclockwise. Make note of pointer location.



50498

a - Shift Shaft Coupler
b - Pointer
c - Scale

d. Determine total degrees of movement.

If 12° or less: Problem is with the drive unit shift cable, upper shift shaft assembly and lever assembly.

If more than 12°: Problem is with gear case shift spool assembly.

Whichever the case, refer to appropriate section for repair of applicable components.

Checking Remote Control Shift Cable Output

IMPORTANT: Remote control must provide a shift cable travel (at the shift plate end) of 2-7/8 in. (73 mm) to 3-1/8 in. (80 mm) with a 15 - 20 lb. (6.8 - 9 kg) load applied to the cable end guide.

Models with Shift Assist: This measurement can be taken by installing the remote control shift cable and using the shift assist assembly (provided) to place the proper load on the shift cable (drive unit shift cable should not be installed).

Models without Shift Assist: This measurement can be taken by lightly pushing and pulling on the remote control shift cable end guide, to place the proper load [15 - 20 lb. (6.8 - 9 kg)] on the shift cable.

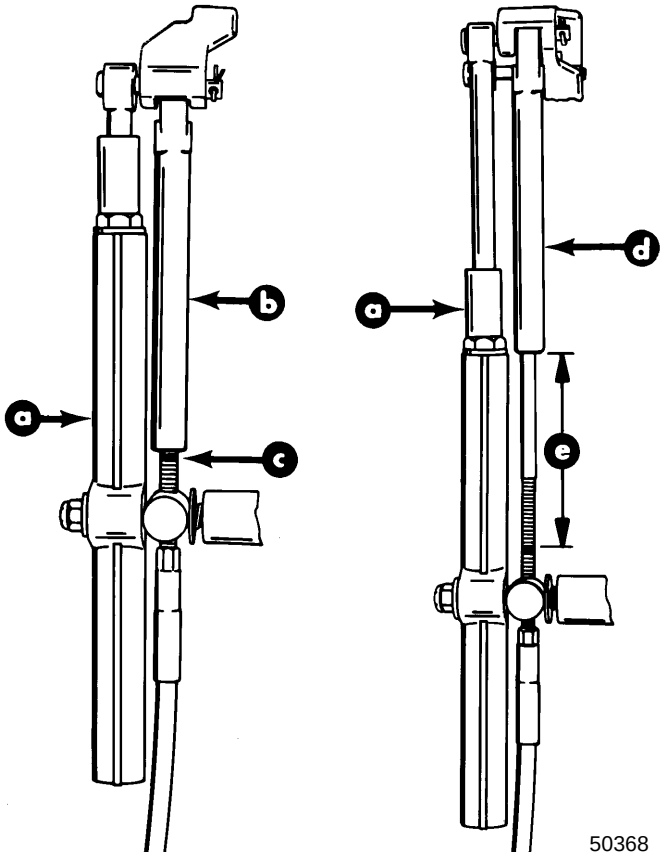
1. Place remote control into gear as follows:

   Right Hand Rotation Drive Unit - forward gear wide-open-throttle position.

   Left Hand Rotation Drive Unit - reverse gear wide-open-throttle position.

   Place a mark on threaded tube against edge of cable end guide.

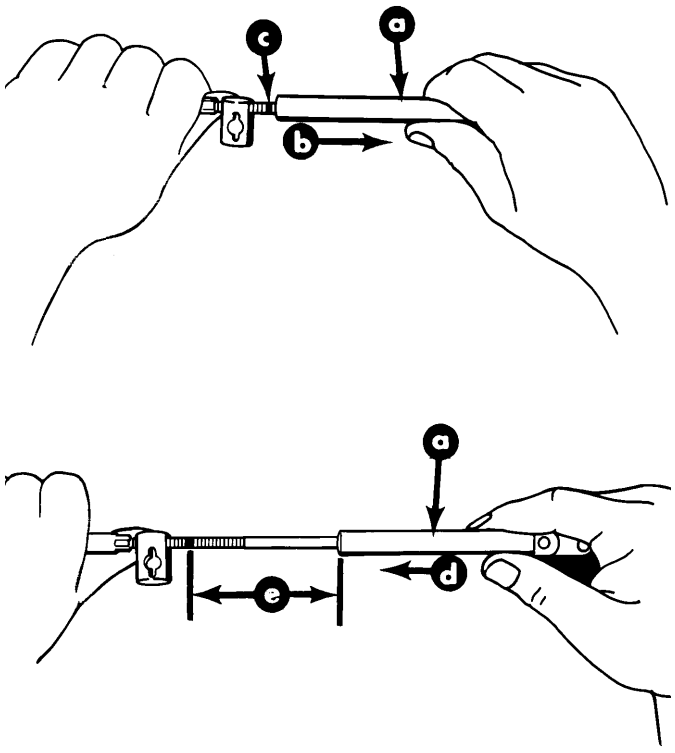
2. Place remote control into the opposite gear from that established in step 1. Measure the distance between the edge of the shift cable end guide and the mark in step 1. Total shift cable output must not be less than 2-7/8 in. (73 mm) or more than 3-1/8 (80 mm). If out put is incorrect, remote control and/or shift cable must be replaced.



50368

With Shift Assist Assembly

a - Shift Assist Assembly
b - Remote Control Shift Cable - Retracted
c - Edge of Cable End Guide Mark
d - Remote Control Shift Cable - Extended
e - Measurement Taken from Mark to Edge of Cable End Guide: **2-7/8 in. (73 mm) to 3-1/8 in. (80 mm)**



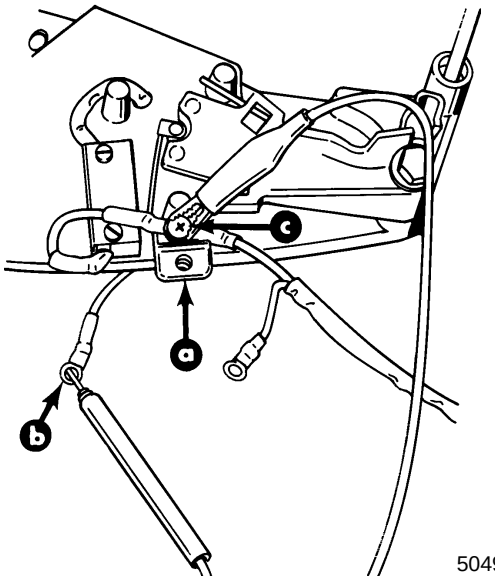
50499

Without Shift Assist Assembly

a - Shift Cable End Guide
b - Remote Control Shift Cable - Lightly Pull on End Guide
c - Place a Mark on Tube Against Edge of Cable End Guide
d - Remote Control Shift Cable - Lightly Push In on End Guide
e - Measurement Taken from Mark to Edge of Cable End Guide: **2-7/8 in. (73 mm) to 3-1/8 in. (80 mm)**

Checking Cutout Switch Timing

1. Disconnect cutout switch white/green wire from terminal block.
2. Connect ohmmeter positive (+) lead to cutout switch white/green wire and ohmmeter negative (-) lead to cutout switch black wire at terminal block.
3. Set ohmmeter on Rx1 scale.

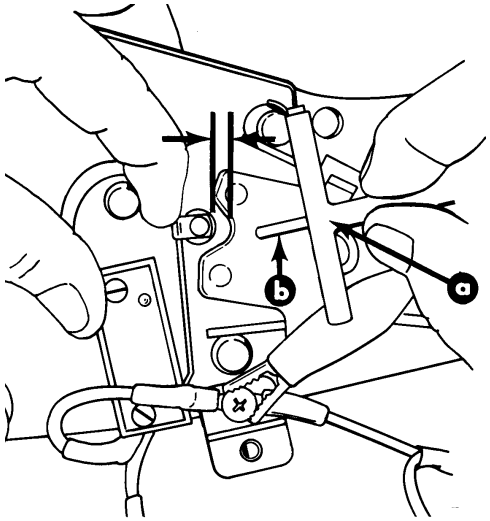


50497

a - Terminal Block
b - Cutout Switch WHITE/GREEN Wire
c - Cutout Switch BLACK Wire

NOTE: *Refer to the end of this section for the pattern and dimensions needed to fabricate a similar tool.*

4. Slowly move cutout switch roller off of its seat. Circuit should close (full continuity reading), when roller is moved 1/8 in. (3 mm). Use the 1/8 in. rod on the end of special tool to gauge this movement.



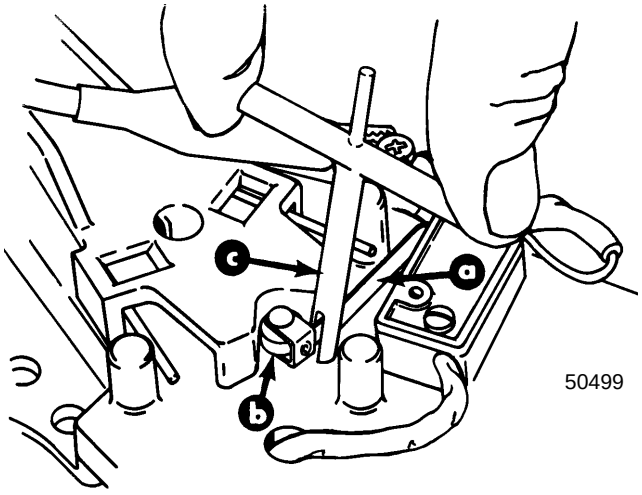
50497

a - Special Tool
b - 1/8 in. (3 mm)

If switch closes too early [less than 1/8 in. (3 mm)]: Roller must be bent away from its seat.

If switch closes too late [more than 1/8 in. (3 mm)]: Roller must be bent toward its seat.

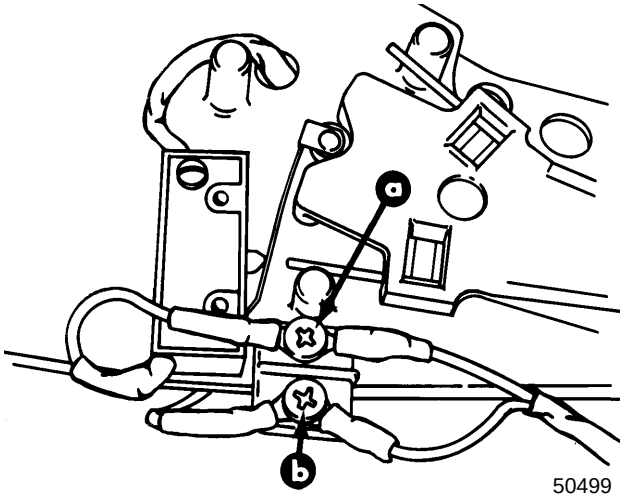
If necessary, use special tool to bend lever as shown.



50499

a - Lever
b - Roller
c - Special Tool

5. Once cutout switch is timed properly, reconnect wires at terminal block and coat terminals with liquid neoprene.



50499

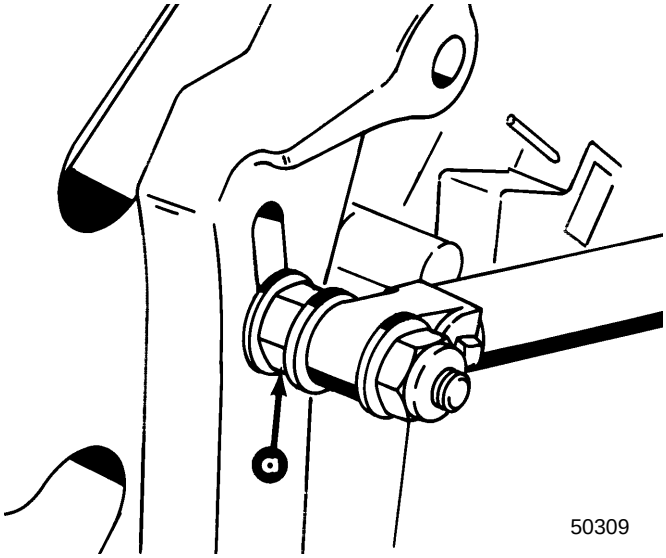
a - BLACK Wires
b - WHITE/GREEN Wires

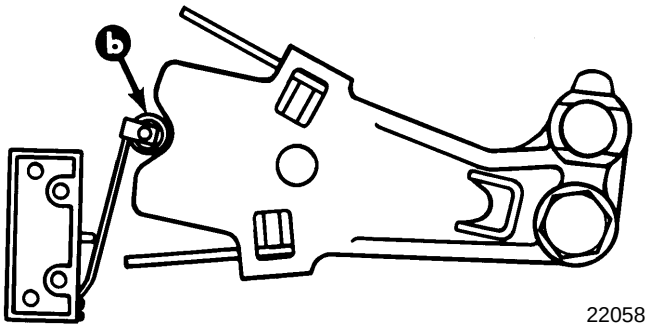
6. Shift remote Control into gear as follows:

Right Hand Rotation Drive Unit - reverse gear wide open-throttle position.

Left Hand Rotation Drive Unit - forward gear wide open-throttle position.

While shifting, rotate propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with gear. Retighten stud. Shift remote control several times and ensure that shift cutout switch roller is still centered.



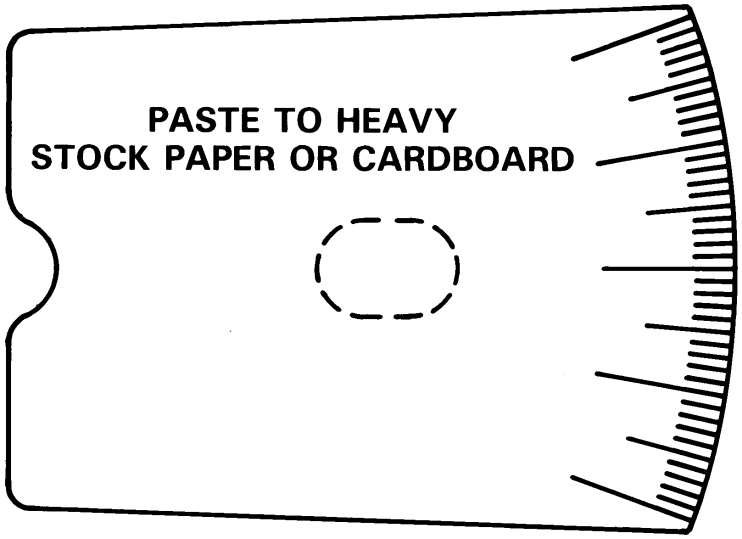


a - Adjustable Stud
b - Shift Cutout Switch Roller

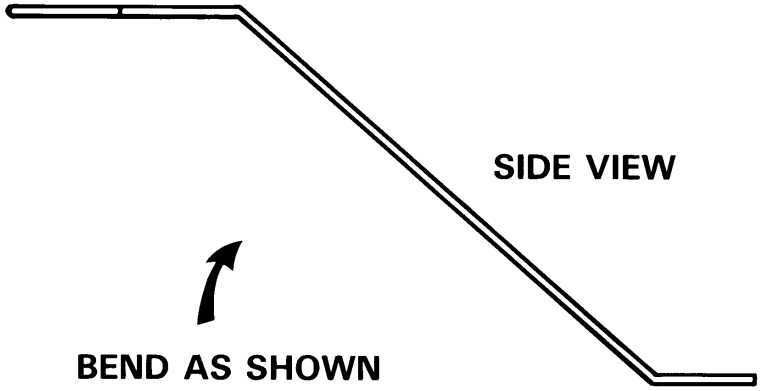
Checking Operation

1. Reconnect throttle cable(s) removed earlier.
2. Place boat in water and start engine. Check the following:
   a. Shift into forward and reverse gear, making sure that clutch engages before engine begins to accelerate.
   b. Accelerate engine in forward and reverse gear to ensure engine does not shut down.
   c. Check that shift cutout switch roller is centered in notch of shift cutout lever, with drive unit in forward and reverse gear.
   d. Shifting from “in gear position” to neutral, ensure drive unit is in neutral before remote control shift lever comes to neutral detent position.

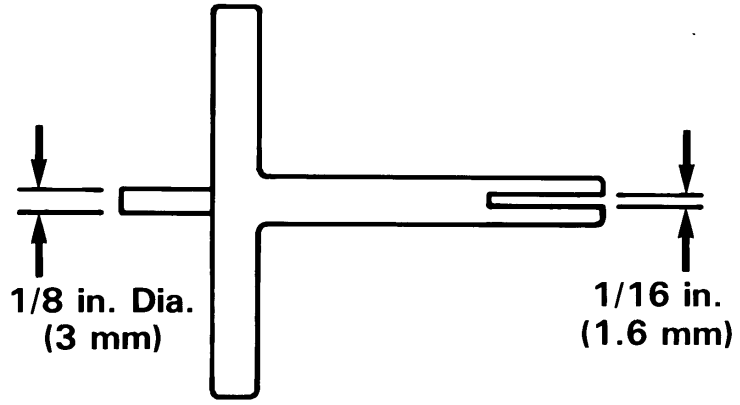
SCALE

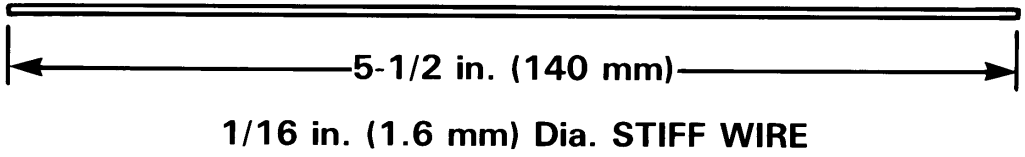


POINTER



CUTOUT SWITCH ADJUSTMENT TOOL

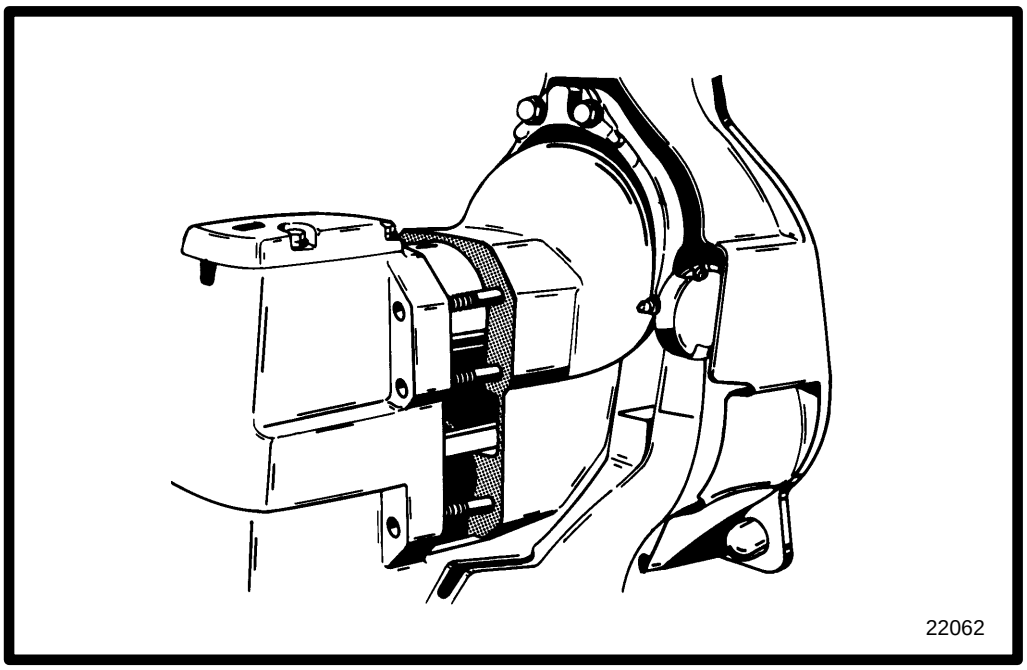




50375

REMOVAL, INSTALLATION AND ADJUSTMENTS

2
A



ALL MODELS

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Specifications

Torque Specifications

NOTE: *Listed below are the torque specifications for those fasteners which have a specific torque value. Tighten all other fasteners (not listed) securely.*

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Exhaust Pipe To Gimbal Housing Screws		20-25	27-34
Power Trim Cylinder To Anchor Pin Nut	Tighten Until Nut Just Bottoms Out		
Propeller		55 (Min.)	75 (Min.)
Shift Cable End Guide Attaching Nuts	Tighten Until Nut Bottoms And Then Loosen 1/2 Turn		
Steering Cable Coupler Nut		35	48
Steering Cable Coupler Nut Locking Plate Screw	60-72		7-8
Steering System Pivot Bolts		25	34
Sterndrive Unit To Bell Housing Attaching Nuts		50	68
Transom Assembly Attaching Screws and Nuts		20-25	27-34
Power Steering Hydraulic Hose Fitting - Large		20-25	27-34
Power Steering Hydraulic Hose Fitting - Small	96-108		11-12

Lubricants/Sealers/ Adhesives

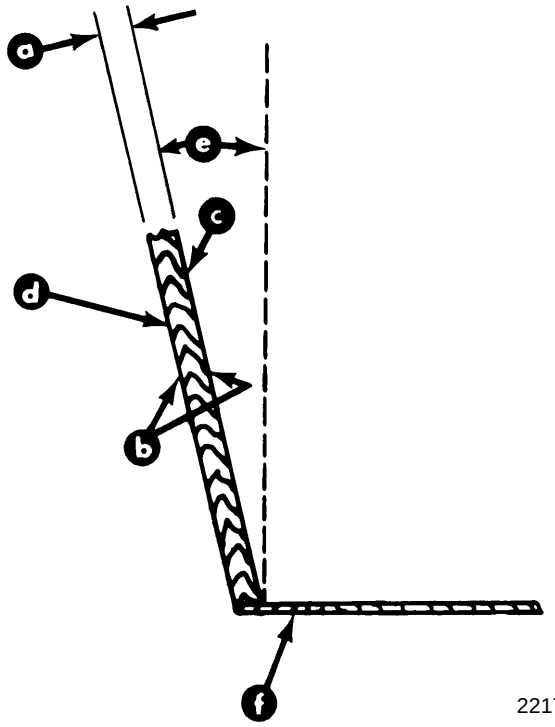
Description	Part No.
Quicksilver 2-4-C Marine Lubricant With Teflon	92-825407A3
Quicksilver Special Lubricant 101	92-13872A1
Liquid Neoprene	92-25711-2
Perfect Seal	92-34227--1
Engine Coupler Spline Grease	92-816391A4

Special Installation Tools

Description	Part No.
Alignment Tool Assembly	91-805475A1
Engine Alignment Tool	91-57797A3

Special Information

Transom Specifications



a - Transom Thickness-to Be 2 In. (51 mm) Minimum To 2-1/4 in. (57 mm) Maximum

b - Transom Surfaces-MUST BE Parallel Within 1/8 in. (3.2 mm) Measured At Top And Bottom Of Cutout Hole

c - Area Covered By Inner Transom Plate-MUST BE Flat Within 1/8 in. (3.2 mm)

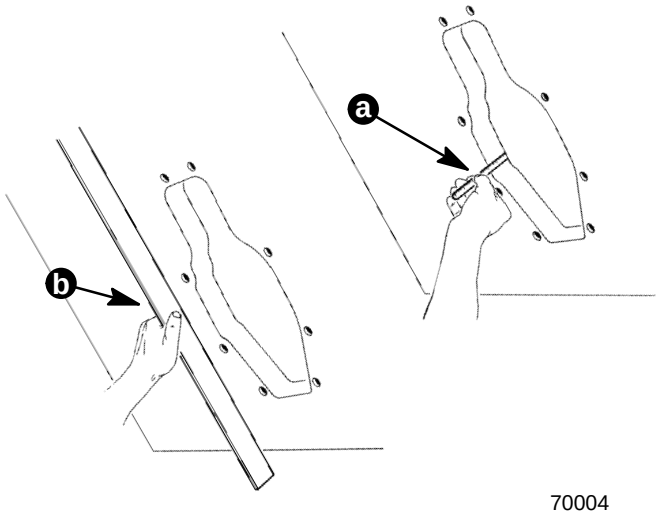
d - Area Covered By Gimbal Housing Assembly-MUST BE Flat Within 1/16 in. (1.6 mm)

e - Transom Angle-10° to 16°

f - Keel (If Equipped)-Remove 4 Ft. (1.2m) Forward To Transom

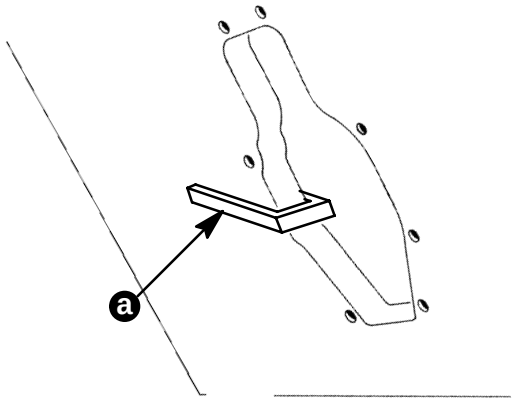
Checking Transom Thickness

Ensure transom surface thickness and flatness conform to minimums specified in “Installation Requirements” listed previously.



70004

a - Measuring Thickness
b - Measuring Flatness



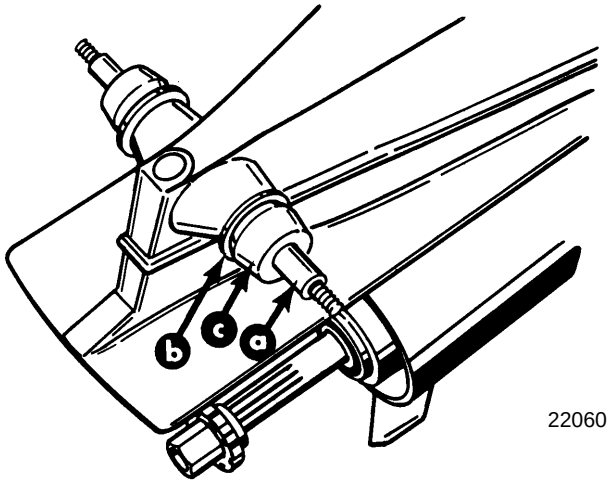
75479

a - Suitable Mandrel To Check For Uniform Transom Thickness

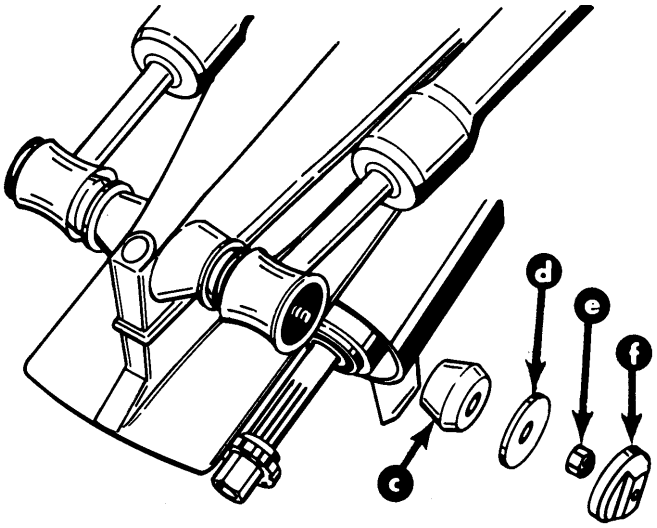
NOTE: *Transom must be between 2” (51 mm) and 2-1/4” (57 mm) a distance of 8” (203 mm) to either side of the vertical centerline.*

Sterndrive Unit Removal

1. Move remote control shift lever into the forward gear position.
2. Remove power trim cylinders (aft end) from drive shaft housing.



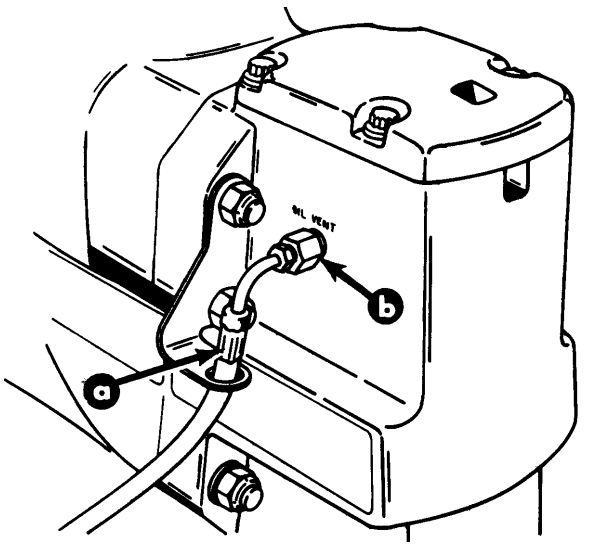
22060



22441

a - Anchor Pin
b - Washers (2)-Large I.D.
c - Rubber Bushings (4)
d - Washer (2)-Small I.D.
e - Locknuts (2)
f - Plastic Caps (2)

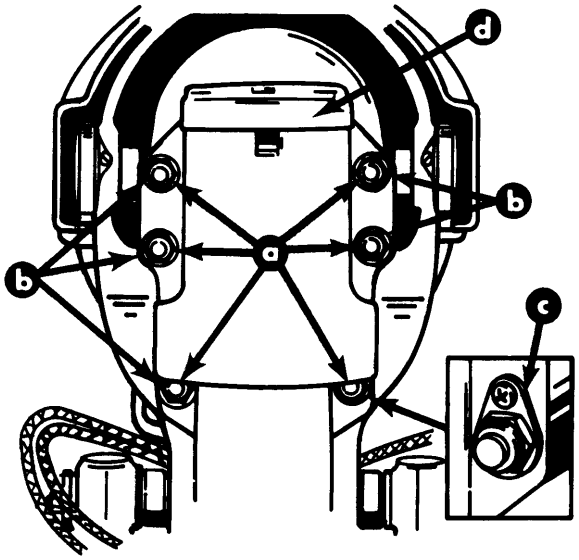
3. If installed, remove and cap remote oil reservoir hose. Remove adaptor fitting and plug drive unit vent hole.



23253

a - Oil Reservoir Hose
b - Adaptor Fitting

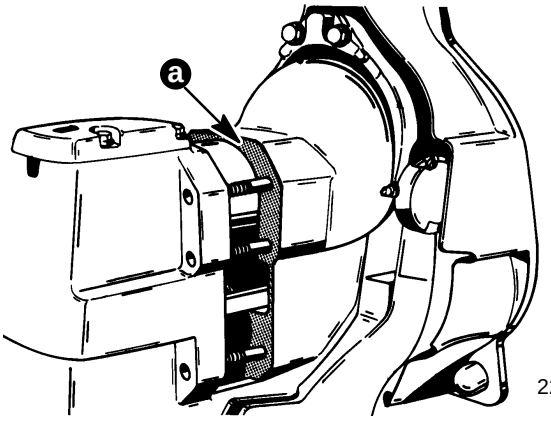
4. Remove locknuts and washers holding drive unit to bell housing. Keep ground plate secured to drive shaft housing. Pull drive unit straight away from bell housing.



22062

a - Locknuts (6)-Remove
b - Washers (5)-Remove
c - Ground Plate
d - Sterndrive Unit

5. Remove bell housing gasket.

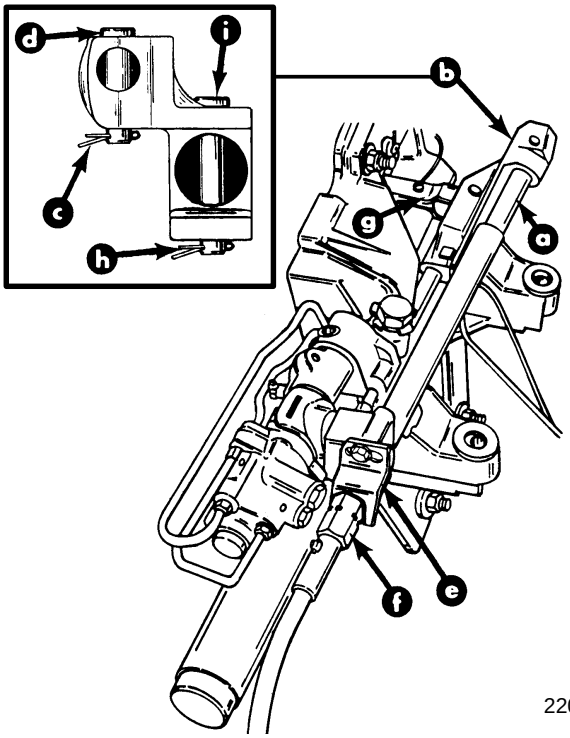


22062

a - Bell Housing Gasket

Transom Assembly Removal

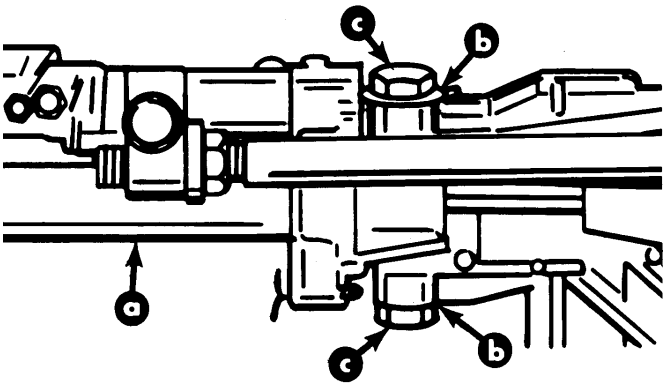
1. If equipped, remove power steering assembly as follows:
   a. Remove cotter pin and clevis pin from clevis. Loosen the cable retaining nut. Disconnect clevis from steering lever.
   b. Remove cotter pin and clevis pin from the steering lever. Disconnect steering cable from clevis.



22023

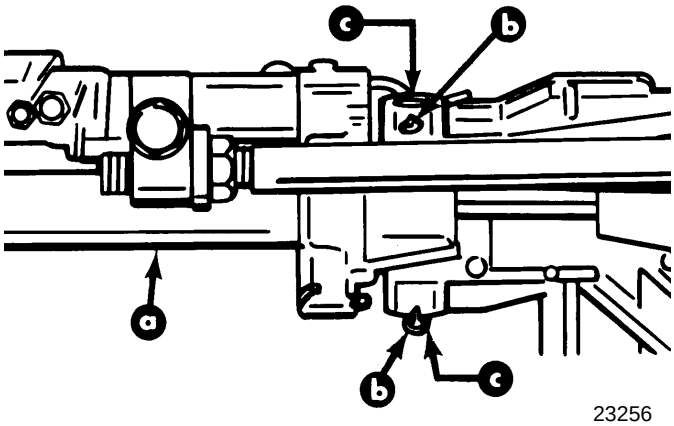
a - Cable End
b - Clevis
c - Cotter Pin
d - Clevis Pin
e - Locking Plate
f - Cable Retaining Nut
g - Steering Lever
h - Cotter Pin
i - Clevis Pin

c. Bend tab on tab washer down. Loosen pivot bolts or remove pivot pins. Use a screw to remove pivot pins. Remove power steering unit.



23256

Power Steering Units Secured With Pivot Bolts



23256

Power Steering Units Secured With Pivot Pins

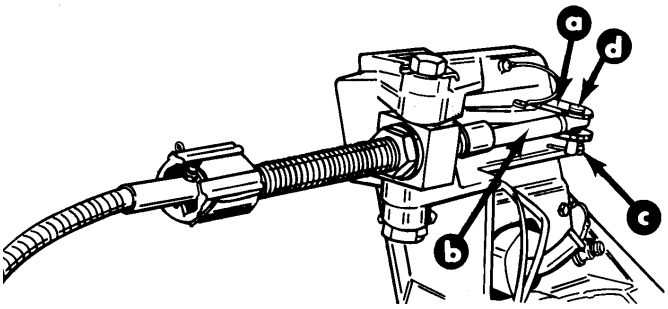
a - Power Steering Unit
b - Tab Washer
c - Pivot Bolt
a - Power Steering Unit
b - Cotter Pins
c - Pivot Pins

2. If equipped, disconnect manual steering as follows:

   a. Remove cotter pin and clevis pin from clevis. Loosen the cable retaining nut. Disconnect clevis from steering lever.

or

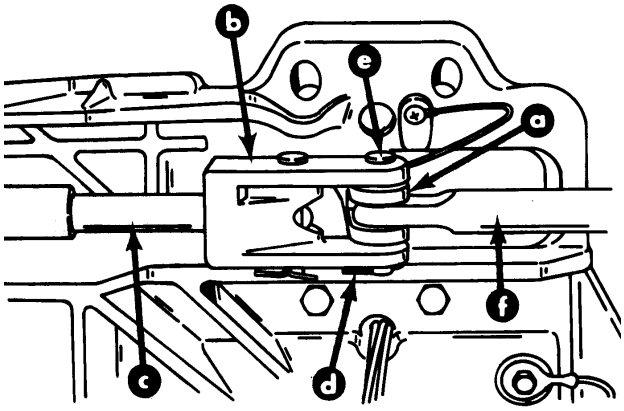
   b. Remove cotter pin and clevis pin from the steering lever. Disconnect steering cable from clevis.



22055

Single Installation Models

a - Steering Lever
b - Steering Cable
c - Cotter Pin
d - Clevis Pin

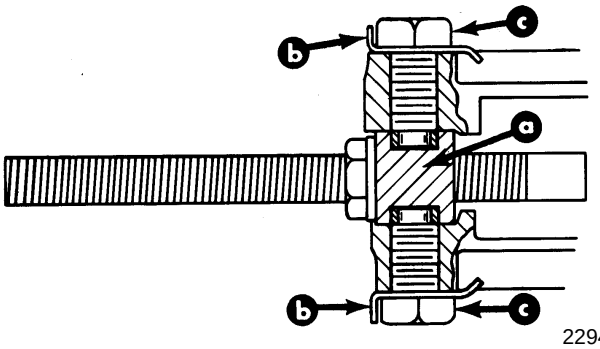


50483

Dual Installation Models

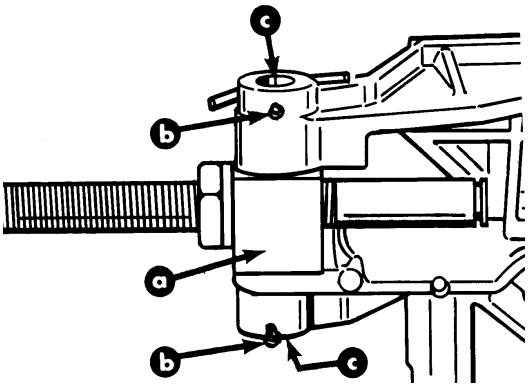
a - Steering Lever
b - Clevis Assembly
c - Steering Cable
d - Cotter Pin
e - Clevis Pin
f - Tie Bar

c. Bend tab on tab washer down. Loosen pivot bolts or remove pivot pins. Use a screw to remove pivot pins. Remove manual steering ring.



22945

Manual Steering Units Secured With Pivot Bolts

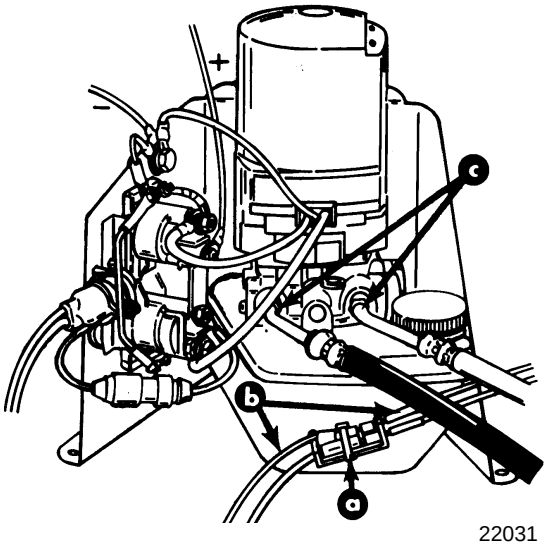


23256

Manual Steering Units Secured With Pivot Pins

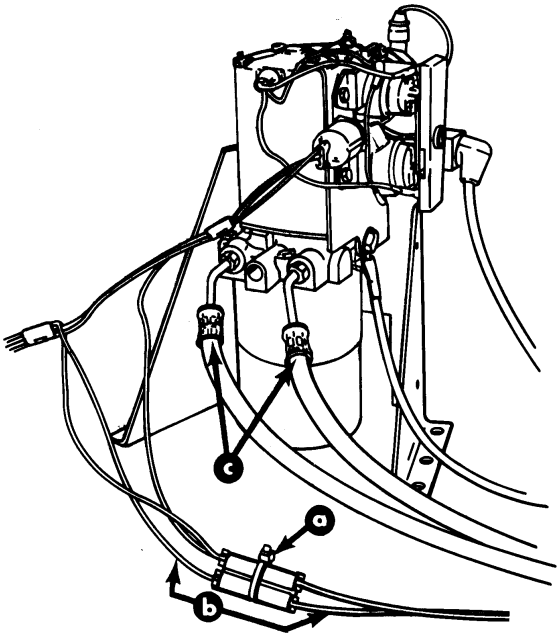
a - Swivel Ring
b - Tab Washer-Bend tab
c - Pivot Bolt
a - Swivel Ring
b - Cotter Pins-Remove
c - Pivot Pins

3. Remove engine (Refer to appropriate Engine Service Manual).
4. Disconnect trim limit switch wires and trim position sender wires.
5. Remove power trim pump hydraulic hoses. Cap hoses and plug pump fitting holes.
6. Remove sta-strap and disconnect trim limit switch wires.



22031

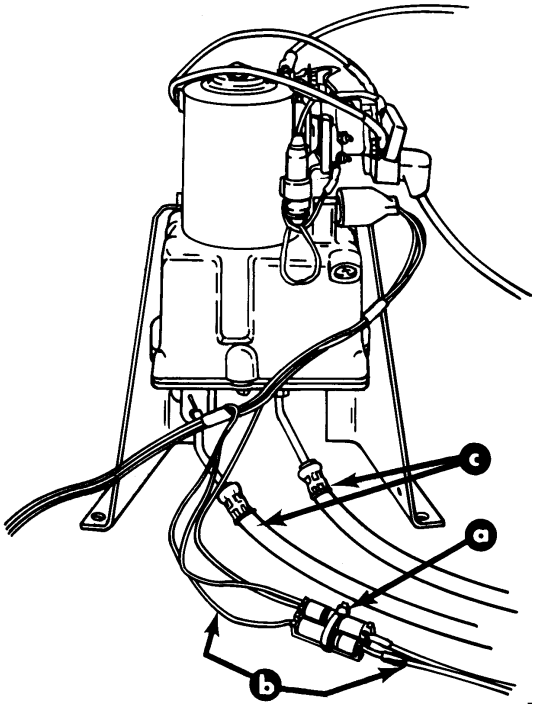
Oildyne Power Trim Pump (Plastic Reservoir)



50483

Oildyne Power Trim Pump (Metal Reservoir)

a - Sta-Strap
b - Trim Limit Switch Wires
c - Hydraulic Hoses

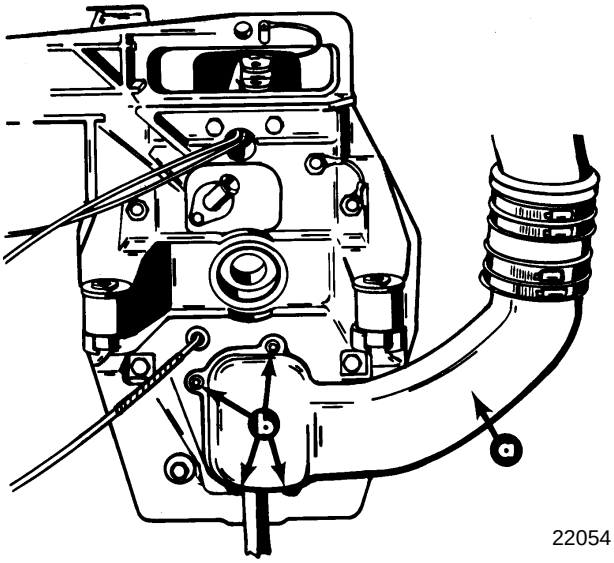


50483

Prestolite Power Trim Pump

a - Sta-Strap
b - Trim Limit Switch Wires
c - Hydraulic Hoses

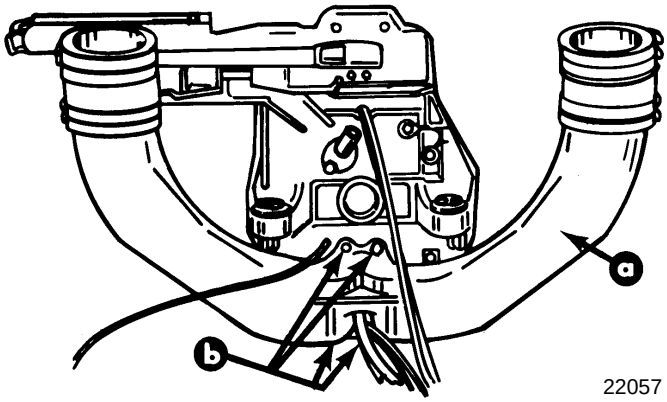
7. If installed, remove exhaust pipe.



22054

In-line 4 Cylinder Models

a - Exhaust Pipe
b - Screws

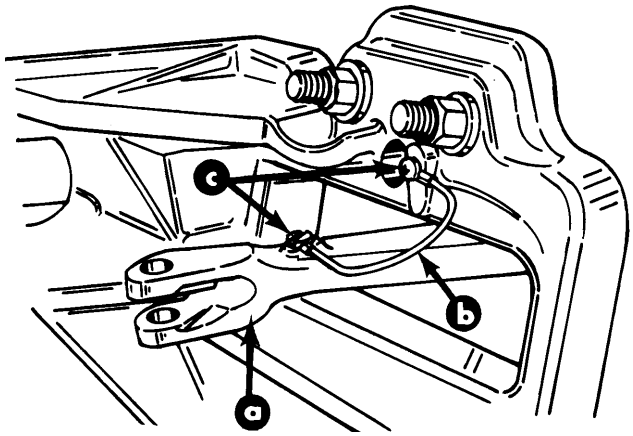


22057

V6/V8 Models

a - Exhaust Pipe
b - Screws

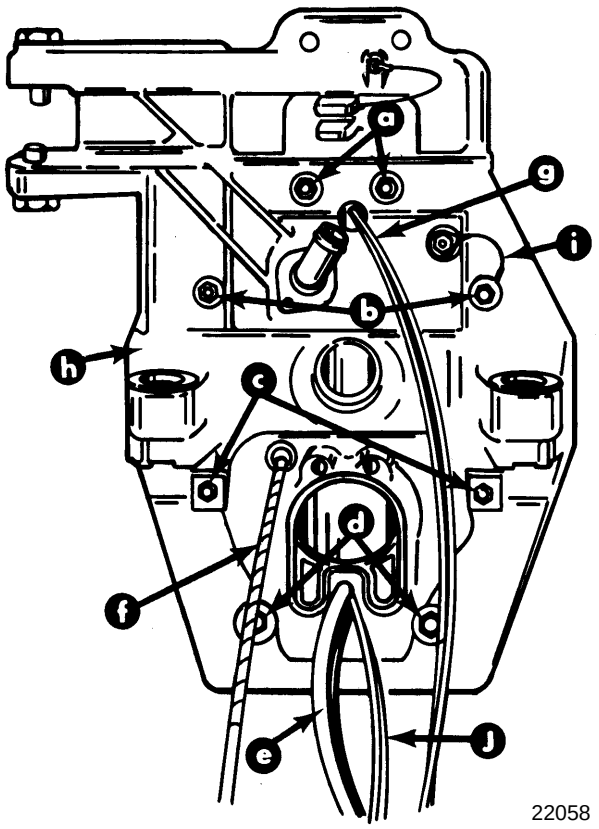
8. Remove ground wire from steering lever.



22028

a - Steering Lever
b - Ground Wire
c - Screws

9. Separate inner transom plate from transom gimbal housing assembly.



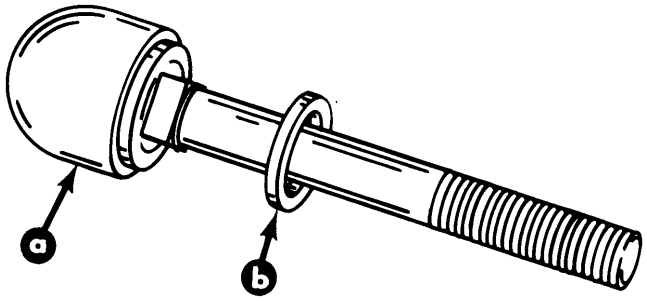
22058

a - Short Screws With Lock Washers
b - Flat Washers And Locknuts
c - Long Screws, Lock Washers And Square Flat Washers
d - Flat Washers And Locknuts (Securing Anode Head Bolts)
e - Hydraulic Hoses
f - Drive Unit Shift Cable
g - Trim Limit And Trim Position Sender Wires
h - Inner Transom Plate
i - Ground Wire (Continuity Circuit)
j - Mercathode Wires (If Equipped)

Transom Assembly Installation

⚠CAUTION

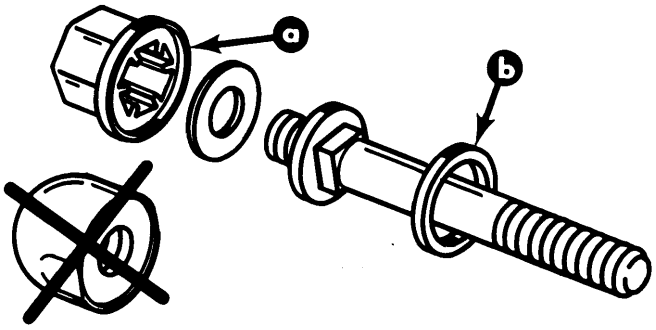
Rubber seal MUST BE installed on anode head bolts, or water will leak into boat.



22028

Non MerCathode Models

a - Anode Head
b - Rubber Seal



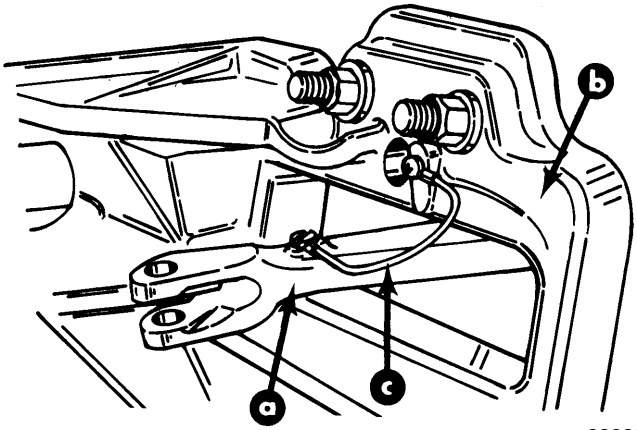
50094

MerCathode Models

a - Plastic Cap
b - Rubber Seal

⚠CAUTION

Steering lever ground wire MUST BE positioned as shown or wire may fatigue.



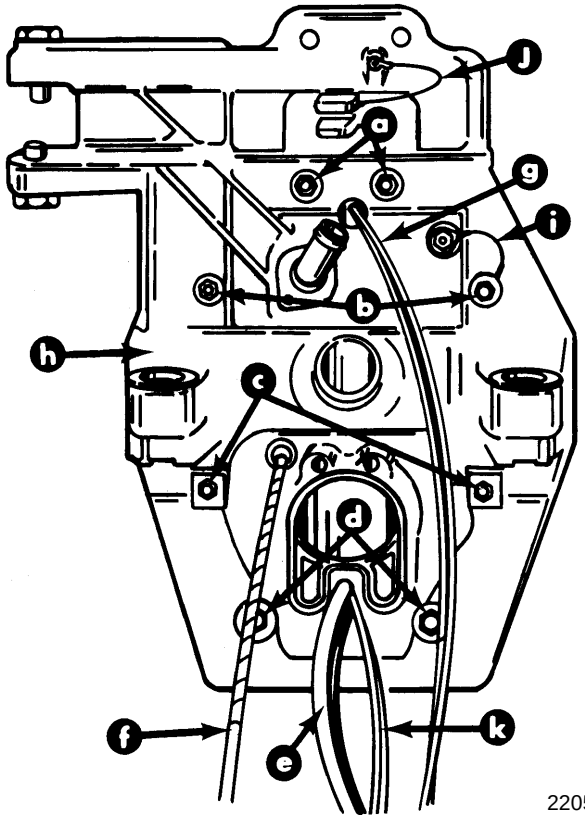
22028

a - Steering Lever
b - Inner Transom Plate
c - Ground Wire

IMPORTANT: Torque bolts and nuts evenly (starting from center and working out) to 20-25 lb. ft. (27-34 N·m).

IMPORTANT: Be sure to pull all wires and cables completely through inner transom plate and ensure wires are not pinched.

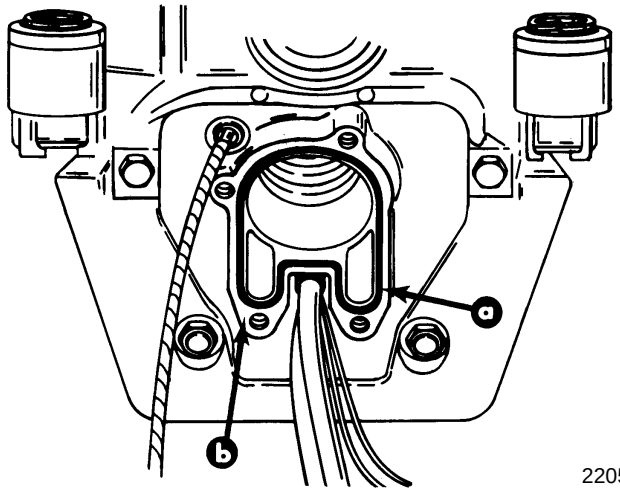
1. Install transom assembly. Tighten attaching bolts and nuts evenly (starting from center and working out). Torque to 20-25 lb. ft. (27-34 N·m).



22058

a - Short Screws And Lock Washers
b - Flat Washers And Locknuts
c - Long Screws, Lock Washers And Square Flat Washers
d - Flat Washers And Locknuts (Securing Anode Head Bolts)
e - Hydraulic Hoses
f - Drive Unit Shift Cable
g - Trim Limit Switch And Trim Position Sender Wires
h - Inner Transom Plate
i - Gimbal Housing To Inner Transom Plate Ground Wire
j - Steering Lever Ground Wire
k - Mercathode Wires (If Equipped)

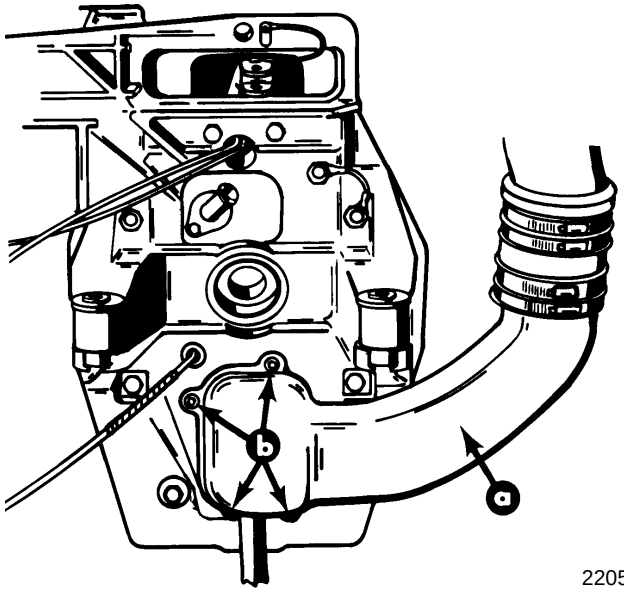
IMPORTANT: Exhaust pipe and gimbal housing mating surfaces must be clean and free of nicks and scratches and O-ring must be properly seated in groove, or water and exhaust may leak into boat.



22057

a - O-ring
b - Mating Surface

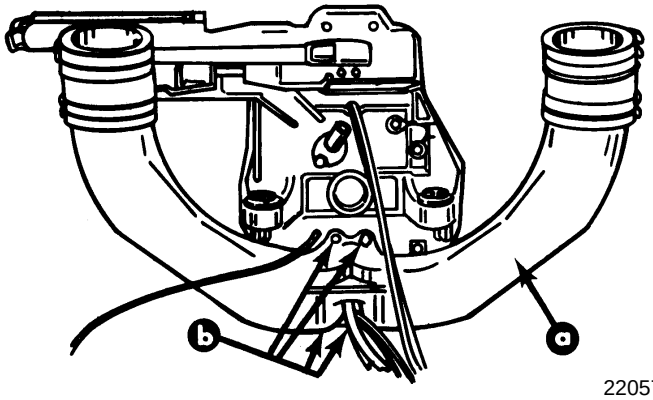
2. If equipped, install exhaust pipe on gimbal housing. Torque screws to 20-25 lb. ft. (27-34 N·m).



22054

In-Line 4 Cylinder Models

a - Exhaust Pipe
b - Screws

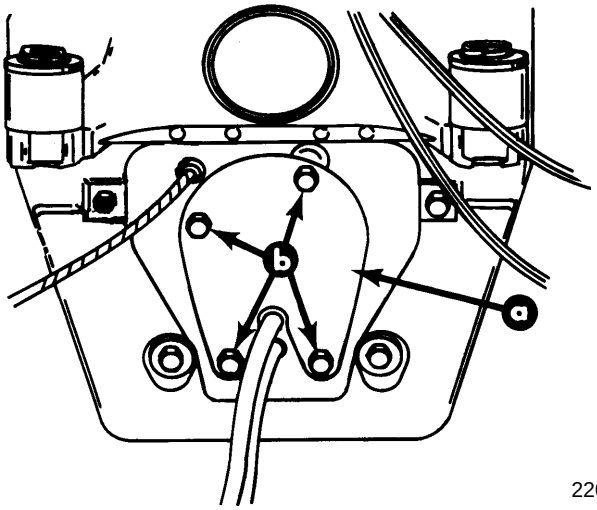


22057

V6/V8 Models

a - Exhaust Pipe
b - Screws

3. If using through-transom exhaust, install block off plate. Torque to 20-25 lb. ft. (27-34 N·m).



22057

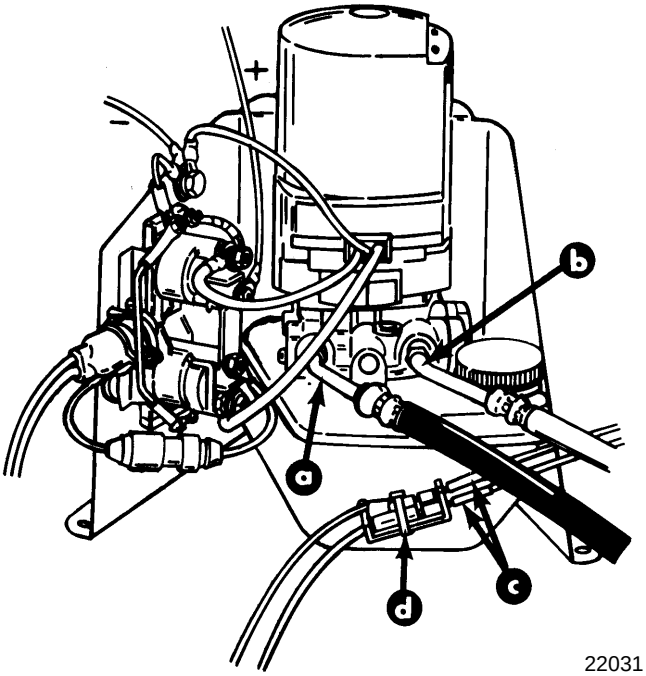
a - Block Off Plate
b - Screws

IMPORTANT: Make hydraulic hose connections as quickly as possible to prevent oil from leaking out of system.

⚠CAUTION

DO NOT cross-thread or overtighten hose fittings when making hydraulic hose connections to power trim pump.

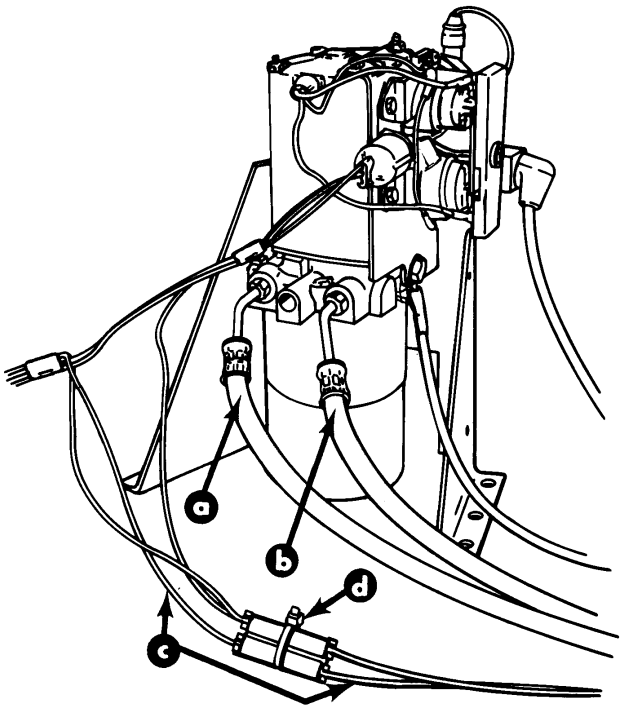
4. Connect power trim pump hydraulic hoses. Torque to 70-150 lb. in. (8-17 N·m).
5. Connect trim limit switch wires.



22031

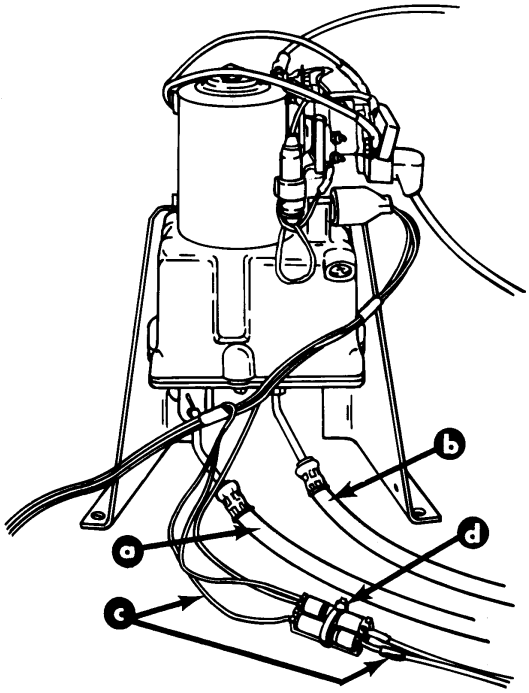
Oildyne Power Trim Pump (Plastic Reservoir)

a - Black Hose (Up Hose)
b - Gray Hose (Down Hose)
c - Trim Limit Switch Wires
d - Wire Retainer And Sta-Strap



50483

Oildyne Power Trim Pump (Metal Reservoir)

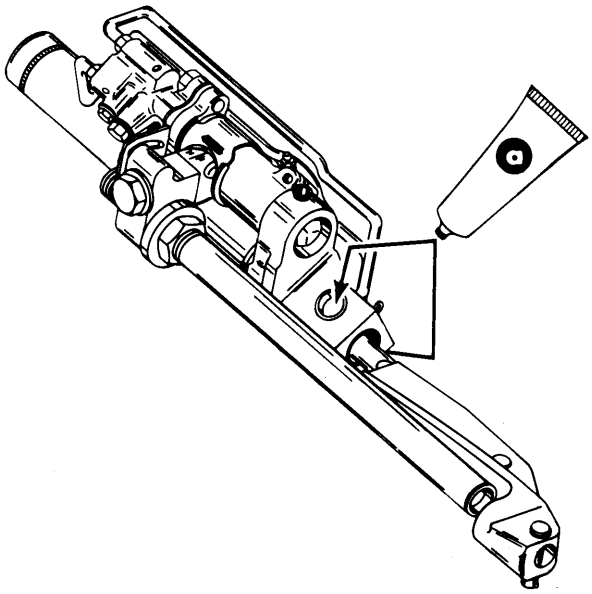


50483

Prestolite Power Trim Pump

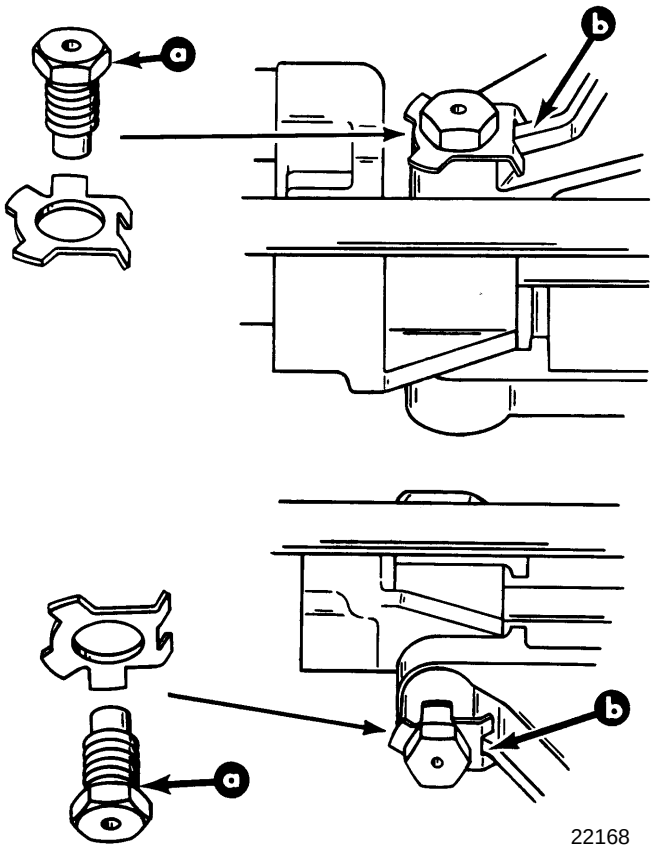
a - Black Hose (Up Hose)
b - Gray Hose (Down Hose)
c - Trim Limit Switch Wires
d - Wire Retainer And Sta-Strap

6. Install engine (refer to appropriate Engine Service Manual).
7. If equipped, install power steering assembly on inner transom plate as follows:
   a. Lubricate swivel ring bushings with Special Lubricant 101.



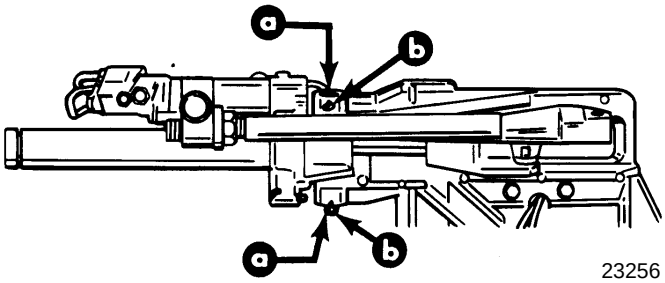
a - Special Lubricant 101

   b. Slide power steering unit swivel ring bushings between transom plate mounting brackets. Install two pivot bolts or two pivot pins with cotter pins and at the same time, slightly moving (wiggling) steering unit to ensure proper pivot pin or pivot bolt engagement into swivel ring bushings. Ensure washer tangs straddle ridges on inner transom plate.



Power Steering Units Secured With Pivot Bolts

a - Pivot Bolts
b - Washer Tangs



Power Steering Units Secured With Pivot Pins

a - Pivot Pins
b - Cotter Pins

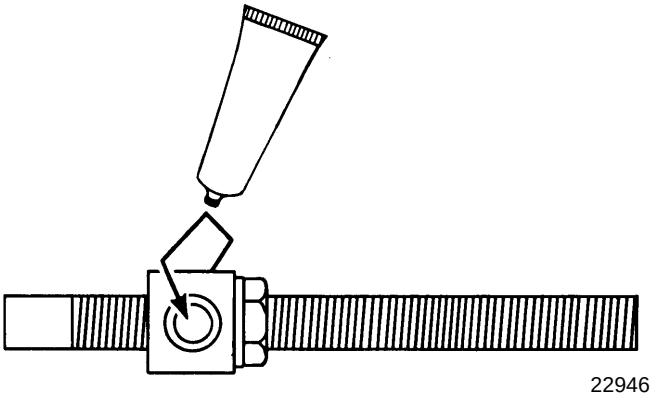
c. Torque pivot bolts to 25 lb. ft. (34 N·m). Bend washer tab against flat on bolt head.

d. If unit is secured with pivot pins, spread cotter pin ends.

e. Check power steering unit to ensure that it pivots freely.

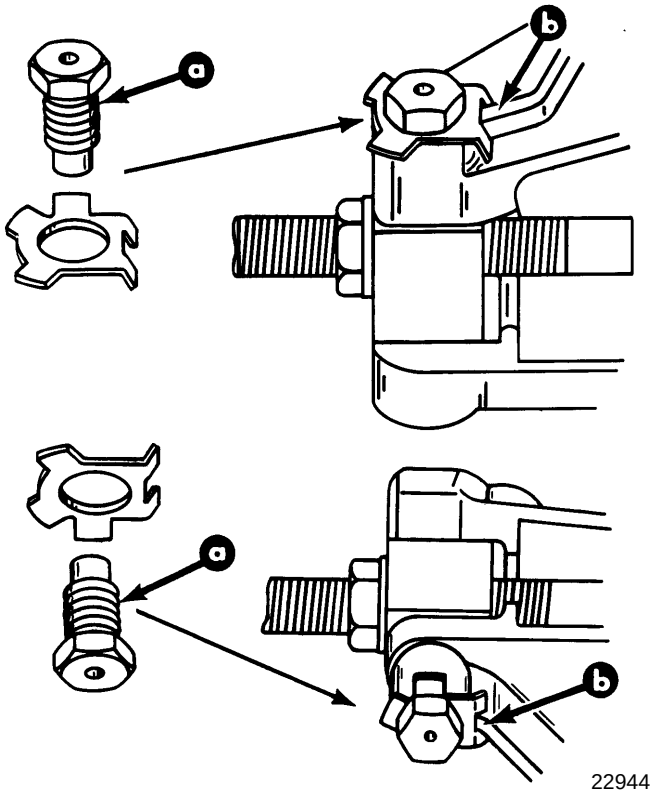
8. If equipped, install manual steering assembly on inner transom plate as follows:

a. Lubricate swivel ring bushings with Special Lubricant 101.



22946

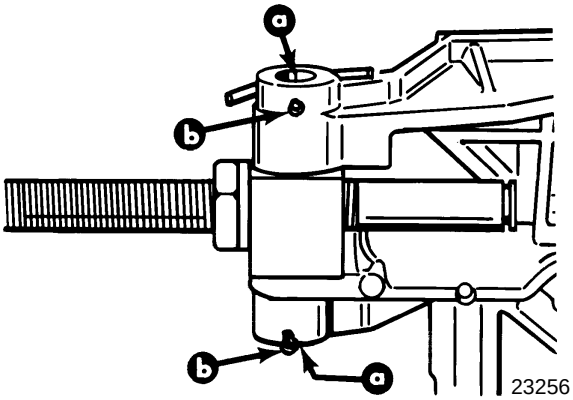
b. Slide manual steering swivel ring bushings between transom plate mounting brackets. Install two pivot bolts or two pivot pins with cotter pins and at the same time, slightly moving (wiggling) swivel ring to ensure proper pivot bolt or pivot pin engagement into swivel ring bushings. Ensure washer tangs straddle ridges on inner transom plate.



22944

Manual Steering Units Secured With Pivot Bolts

a - Pivot Bolts
b - Washer Tangs



23256

Manual Steering Units Secured With Pivot Pins

a - Pivot Pins
b - Cotter Pins

c. Torque pivot bolts to 25 lb. ft. (34 N·m). Bend washer tab against flat on bolt head.

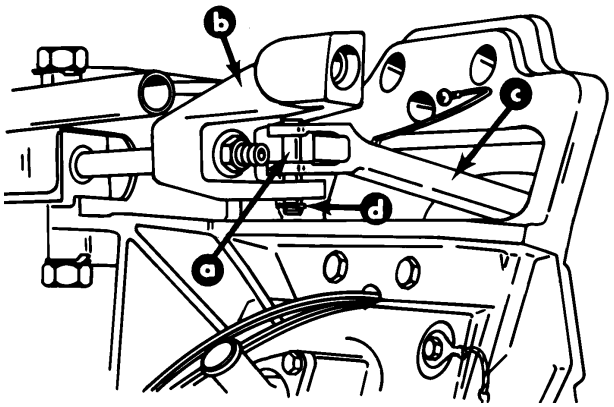
d. If unit is secured with pivot pins, spread cotter pin ends.

9. If equipped, connect power steering unit to steering lever as follows:

   a. Lubricate clevis pin with Special Lubricant 101.

   b. Install clevis pin through clevis and steering lever from top.

   c. Secure clevis pin with cotter pin. Spread both ends of cotter pin.



50483

a - Clevis Pin
b - Clevis
c - Steering Lever
d - Cotter Pin

⚠ WARNING

Steering cable outer casing MUST BE free to move back and forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

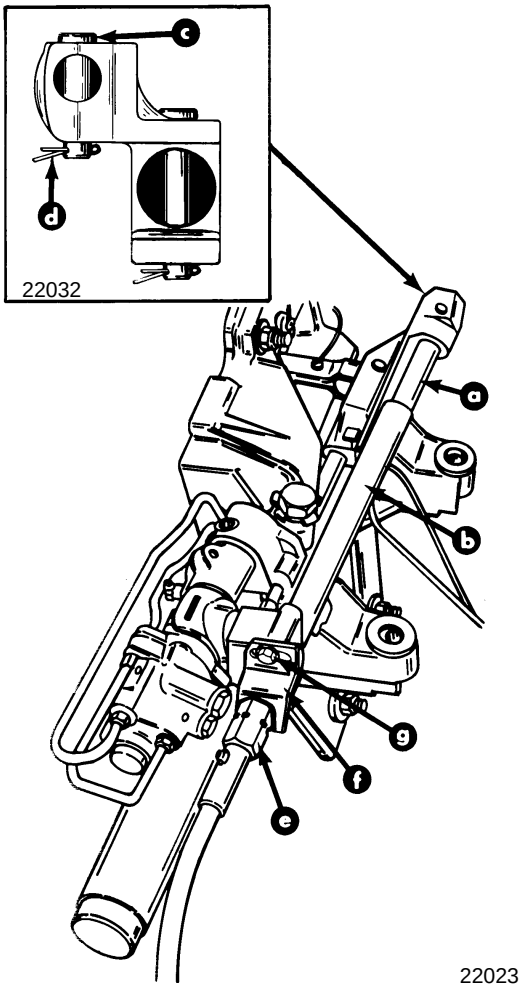
10. If equipped with power steering, install steering cable as follows:

   a. Lubricate steering cable end with a liberal amount of Special Lubricant 101 and install cable end through guide tube.

   b. Connect cable end to clevis with clevis pin. Secure clevis pin in clevis with cotter pin. Spread both ends of cotter pin.

   c. Tighten coupler nut. Torque to 35 lb. ft. (48 N·m).

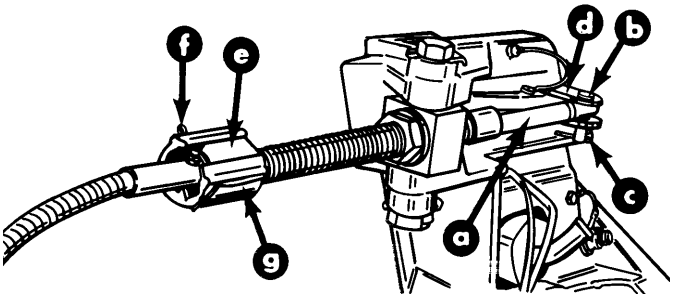
   d. Install locking plate on coupler nut and secure with screw and washer. Torque to 60-72 lb. in. (7-8 N·m).



22023

a - Steering Cable End
b - Cable Guide Tube
c - Clevis Pin
d - Cotter Pin
e - Coupler Nut
f - Locking Plate
g - Screw And Washer

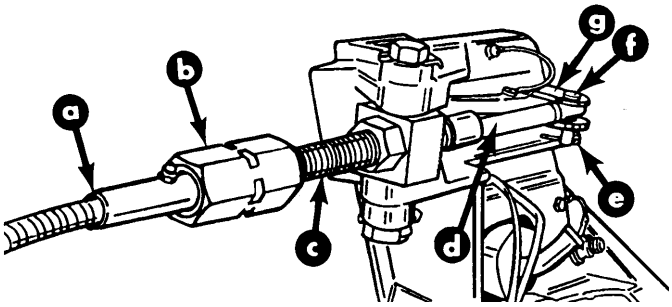
11. If equipped with manual steering, install steering cable as follows:
    a. Lubricate steering cable end with a liberal amount of Special Lubricant 101 and install cable end through guide tube.
    b. On single engine installations; connect steering cable to steering lever and secure with clevis pin and cotter pin. Spread both ends of cotter pin.
    c. On dual engine installations; connect steering cable to clevis assembly and secure with clevis pin and cotter pin. Connect clevis and tie bar to steering lever and secure with clevis pin and cotter pin. Spread both ends of cotter pins.
    d. Tighten coupler nut. Torque to 35 lb. ft. (48 N·m).
    e. Install locking sleeve on coupler nut and secure with cotter pin. Spread both ends of cotter pin.



22055

Single Engine Installation - Earlier Style Steering Cable

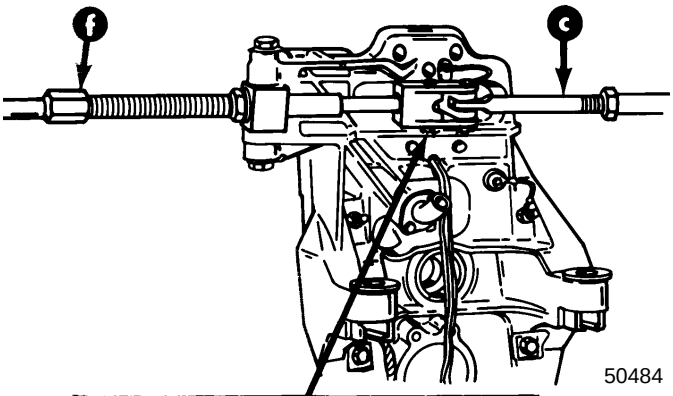
a - Steering Cable End
b - Clevis Pin
c - Cotter Pin
d - Steering Lever
e - Coupler Nut
f - Cotter Pin
g - Locking Sleeve



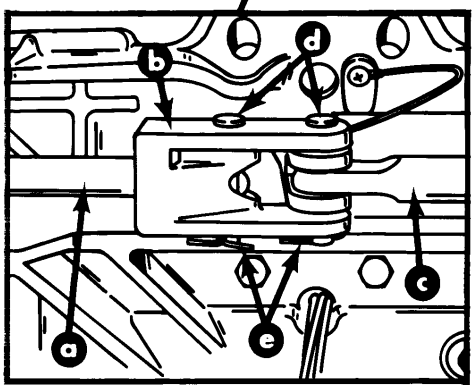
70373

Single Engine Installation - Later Style Steering Cable

a - Steering Cable
b - Cable Coupler Nut
c - Steering Cable Guide Tube
d - Steering Cable End
e - Cotter Pin
f - Clevis Pin
g - Steering Lever



50484

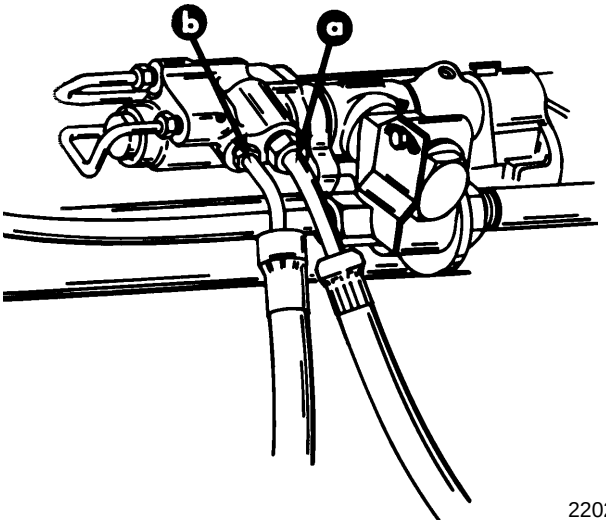


50483

Dual Engine Installation

a - Steering Cable End
b - Clevis Assembly
c - Tie Bar
d - Clevis Pins
e - Cotter Pins
f - Coupler Nut

12. Connect power steering hydraulic hoses to their corresponding fittings on the control valve. Torque large hose fitting to 20-25 lb. ft. (27-34 N·m). Torque small hose fitting to 96-108 lb. in. (11-12 N·m).



22023

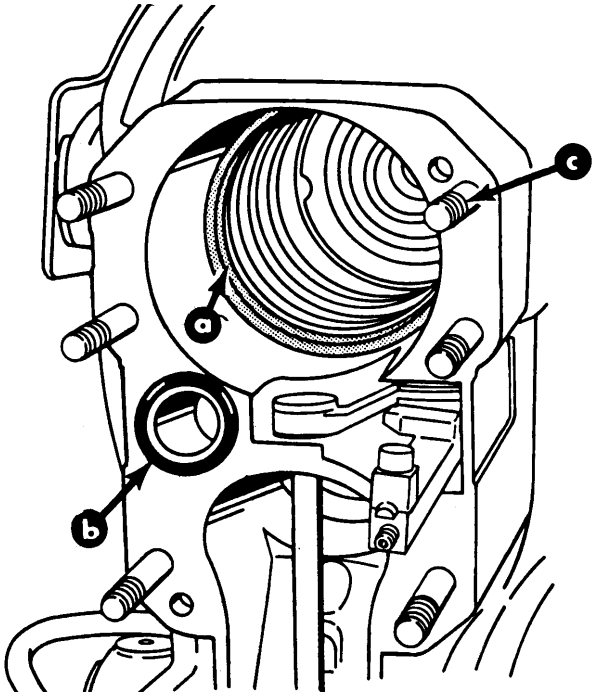
a - Large Fitting
b - Small Fitting

Sterndrive Unit Installation

1. Install and align engine. (Refer to appropriate Engine Service Manual).

IMPORTANT: Rubber gasket must be properly positioned in bell housing bore before installing drive unit, or water may leak into boat.

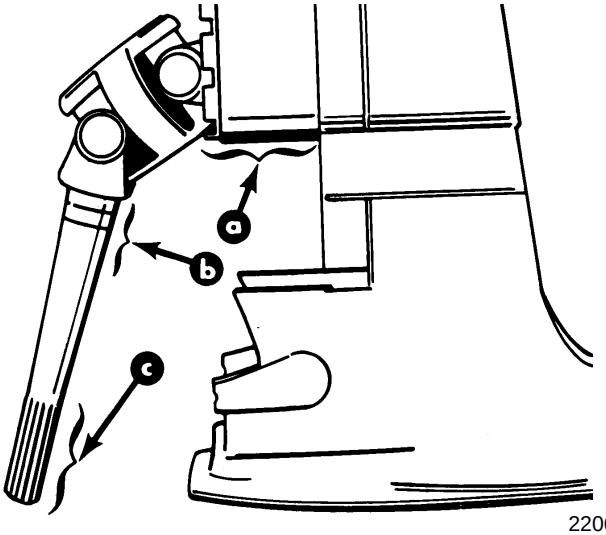
2. Ensure that rubber gasket and water passage O-ring are properly positioned in bell housing.
3. Coat entire stud and threads with 2-4-C Marine Lubricant.



50636

a - Rubber Gasket
b - Water Passage O-ring
c - Studs

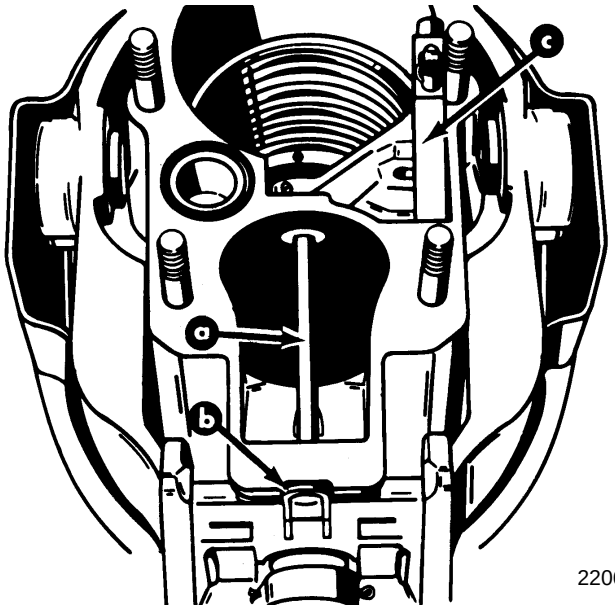
4. Coat drive unit pilot and drive shaft O-rings with 2-4-C Marine Lubricant. Coat the driveshaft splines with Engine Coupler Spline Grease.



22061

a - Drive Shaft Pilot
b - Drive Shaft O-rings
c - Drive Shaft Splines

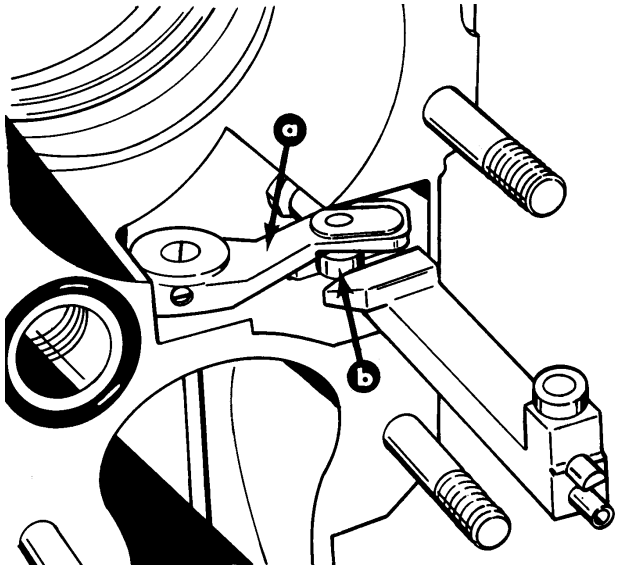
5. Position bell housing shift shaft coupler so that slot in coupler is positioned straight fore and aft. Do this by placing remote control shift lever in: **Forward gear position for RH drive or Reverse gear position for LH drive unit.**



22061

a - Shift Shaft
b - Shift Shaft Coupler
c - Shift Slide

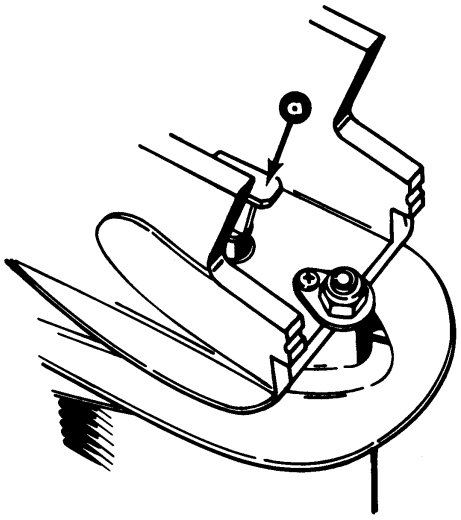
IMPORTANT: Shift slide assembly is free to rotate on core wire, therefore, be careful that shift slide remains in upright position and is properly engaged with shift shaft lever while installing drive unit.



50629

a - Shift Shaft Lever
b - Roller

6. Position drive unit shift shaft coupler so that is straight forward by turning coupler clockwise while simultaneously turning propeller shaft counterclockwise.



22061

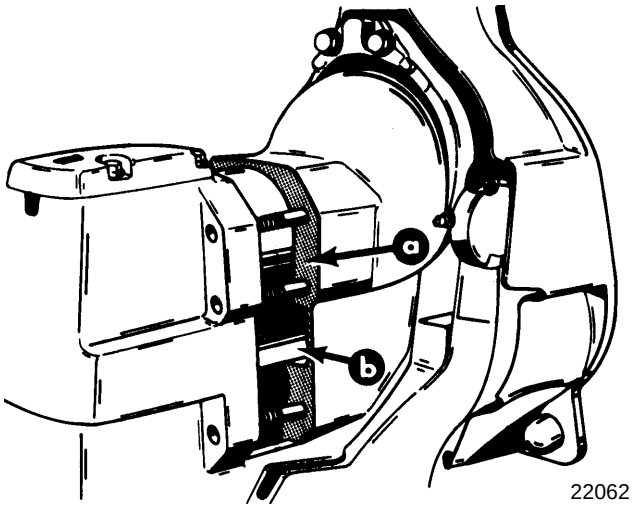
a - Drive Unit Shift Shaft Coupler

IMPORTANT: Be sure to install RH or LH drive unit on the appropriate transom assembly when making dual engine installations. The LH rotation drive unit can be identified by the decal on the back side of the upper drive shaft housing, which states:
"Alpha One-Counter Rotation"

7. Place gasket on bell housing.
8. Install sterndrive unit as follows:
   a. Position trim cylinder straight back (over top of acceleration plate). Be careful not to scratch acceleration plate or trim cylinders.
   b. Guide U-joint shaft through gimbal bearing and into engine coupler while simultaneously guiding shift slide into drive shaft housing. Make sure shift slide remains upright and engaged with bell housing shift shaft lever.

IMPORTANT: If drive unit will not slide all the way into bell housing, check shift shaft coupler to ensure they are positioned properly. Do not force drive unit into position.

   c. If necessary, rotate propeller shaft **counterclockwise** slightly to help align U-joint shaft splines with engine coupler splines, then, slide drive unit all-the-way into bell housing.

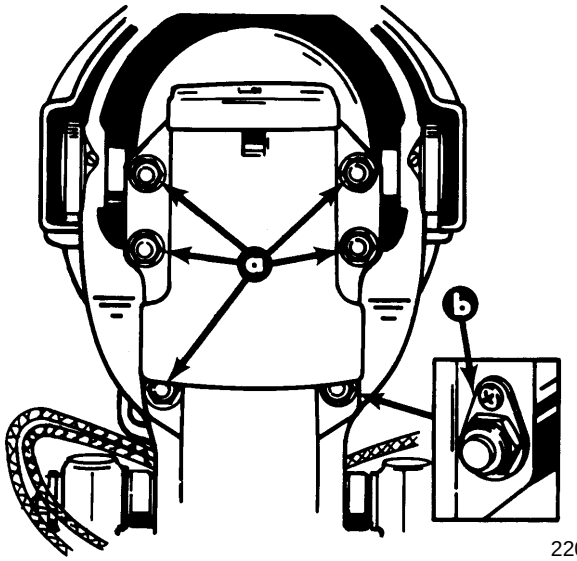


22062

a - Gasket
b - Shift Slide

   d. Return remote control shift lever to the neutral position.

9. Fasten drive unit to bell housing with hardware shown. Torque evenly, starting from center, to 50 lb. ft. (68 N·m).

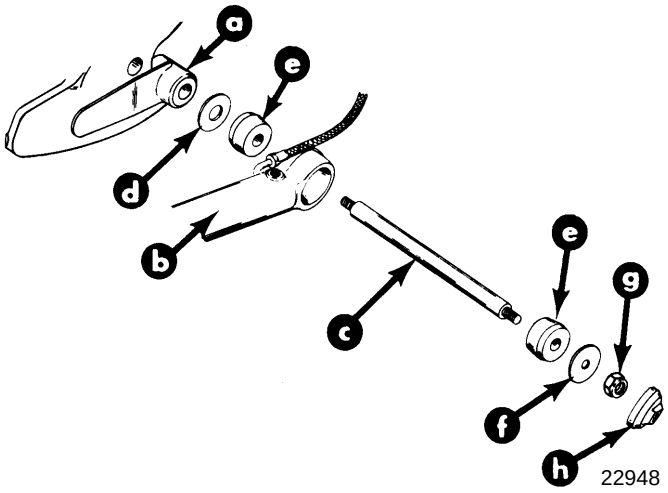


22062

a - Locknuts And Flat Washers
b - Locknut And Ground Plate (Do NOT Use Flat Washer)

IMPORTANT: To aid in installing rubber bushings, use a water and soap solution.

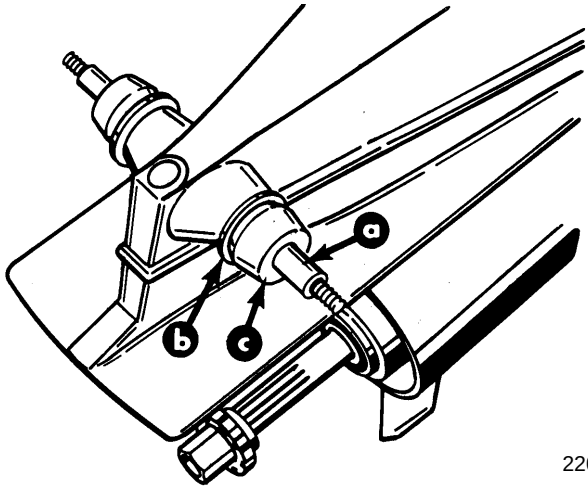
10. If removed, install trim cylinders on gimbal ring. Tighten until locknuts bottom on anchor pin shoulder.



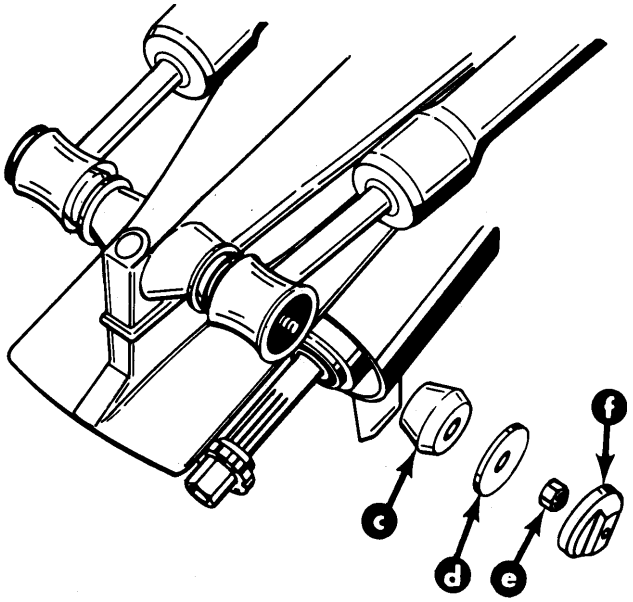
22948

a - Gimbal Ring
b - Trim Cylinders (Port And Starboard)
c - Anchor Pin
d - Flat Washers (2)-Large I.D.
e - Rubber Bushings (4)
f - Flat Washers (2)-Small I.D.
g - Locknuts (2)
h - Plastic Caps (2)

11. Install trim cylinders (Aft End) on drive shaft housing. Tighten locknuts until they bottom on anchor pin shoulder.



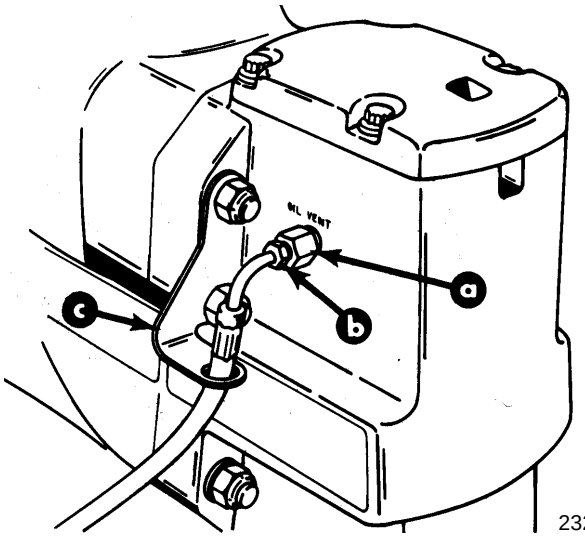
22060



22441

a - Anchor Pin
b - Washers (2)-Large I.D.
c - Rubber Bushings (4)
d - Washers (2)-Small I.D.
e - Locknuts (2)
f - Plastic Caps (2)

12. If equipped, reinstall remote oil reservoir hose. (Refer to Section 1B for filling instructions).

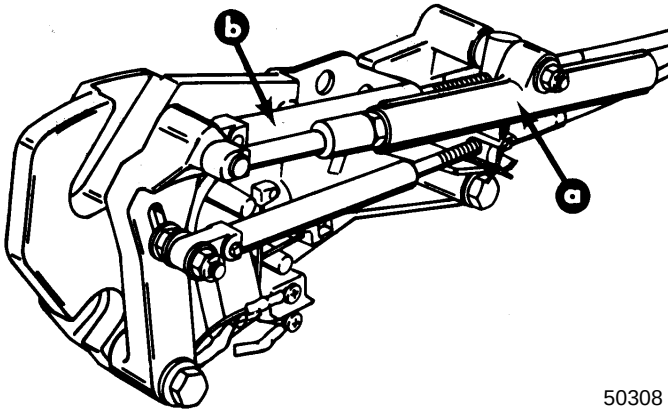


23253

a - Adaptor Fitting
b - Hose Fitting
c - Bracket

Shift Cable Adjustment

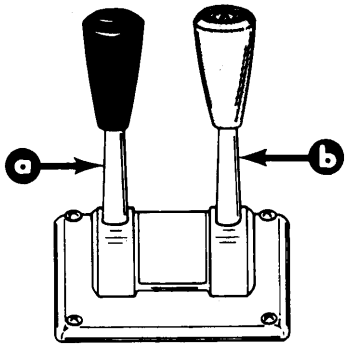
NOTE: *Some models may be equipped with a shift assist assembly. The only difference with these models is that the remote control shift cable attaching hardware is slightly longer. Shift cable adjustment is the same as all other versions.*



50308

a - Shift Assist Assembly
b - Remote Control Shift Cable

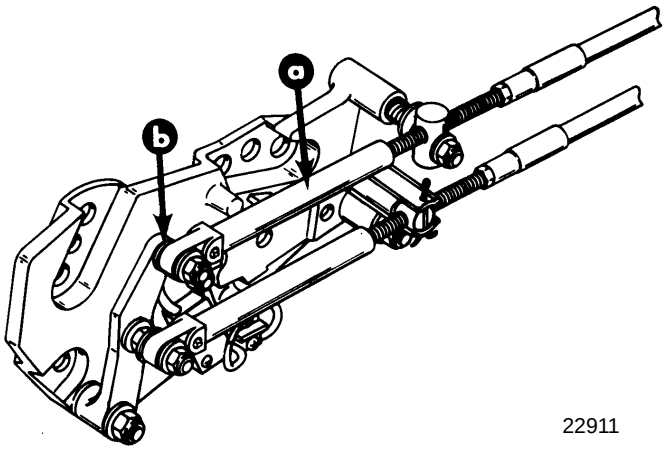
IMPORTANT: If boat is equipped with A REMOTE CONTROL THAT HAS SEPARATE SHIFT AND THROTTLE LEVERS, this shift assist assembly should NOT be used. The use of the shift assist assembly with this type of remote control can cause the shift lever to move out of gear unexpectedly.



71339

a - Shift Lever
b - Throttle Lever

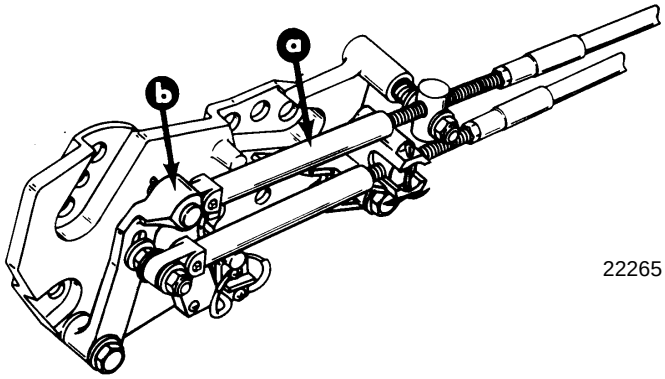
NOTE: *A difference exists between earlier and later model shift plates, in that the later models have a pin and cotter pin to secure the remote control shift cable to the shift lever, whereas the earlier models used a stud with washers and locknut. However, adjustment procedures are the same.*



22911

Earlier Models (With Metal Shift Lever)

a - Remote Control Shift Cable
b - Stud, Washers and Locknut



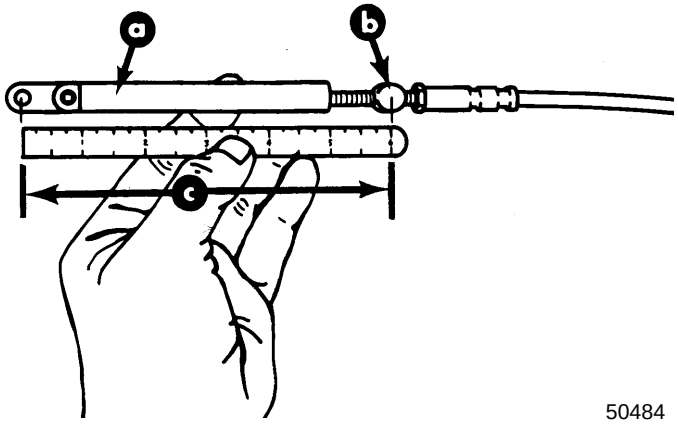
22265

Later Models (With Plastic Shift Lever)

a - Remote Control Shift Cable
b - Pin and Cotter Pin

Installing Shift Cables

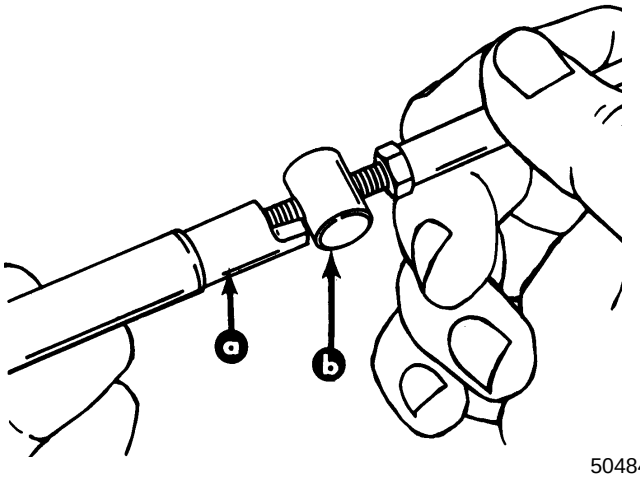
1. Push in on drive unit shift cable while simultaneously turning propeller shaft counterclockwise until shaft stops, to ensure drive unit is completely in gear. Maintain pressure on propeller shaft with a suitable device (elastic strap).
2. Measure distance between center of hole in shift cable end guide and center of brass barrel. Measurement should be 6 in. (153 mm).



50484

a - End guide
b - Brass Barrel
c - 6 in. (153 mm)

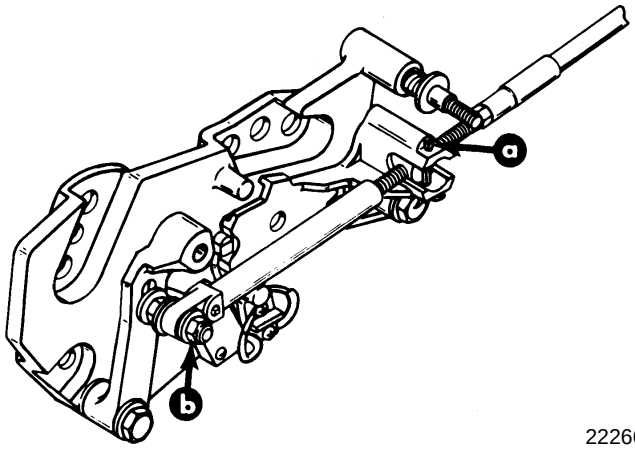
3. **If equipped with shift assist assembly:** Once brass barrel adjustment is correct, install end guide “stop clip” on threaded tube. Position as shown, with tang touching brass barrel.



50484

a - Stop Clip
b - Brass Barrel

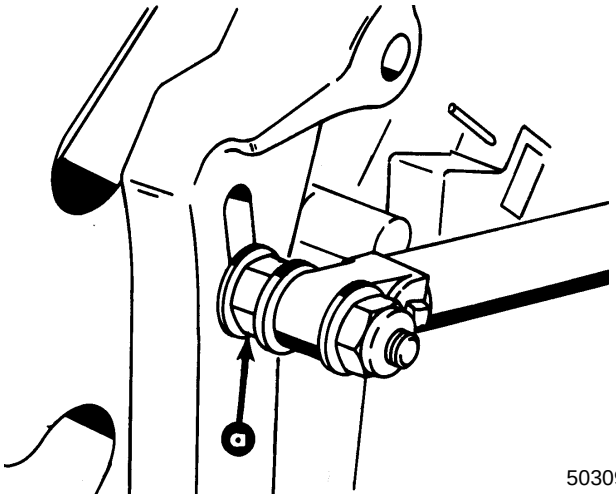
4. Install drive unit shift cable as shown. Secure brass barrel in barrel retainer with cotter pin and spread both prongs. Secure cable end guide with washers (one on each side of end guide) and locknut. Tighten locknut until it bottoms out, then back off 1/4-1/2 turn.



22266

a - Cotter Pin
b - Locknut And Washers

5. Ensure shift lever adjustable stud is at bottom of slot. If necessary, loosen stud and move it to bottom of slot, then retighten stud.



50309

a - Adjustable Stud

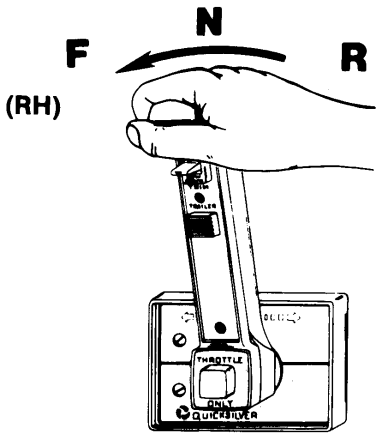
IMPORTANT: Shift cable adjustment for a right hand (RH) rotation drive unit is different than the procedure for adjusting a left hand (LH) rotation drive unit. Be sure to refer to the appropriate procedure when performing the following steps.

IMPORTANT: Drive unit must be installed.

IMPORTANT: DO NOT run engine.

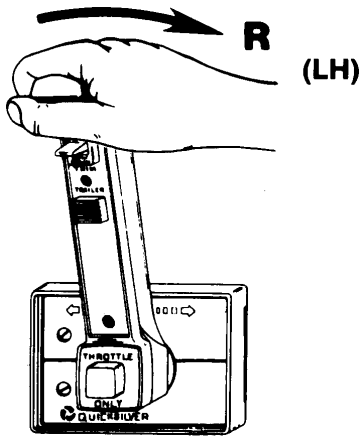
6. Shift remote control as stated in “a” or “b” following:

   a. **Right Hand (RH) Rotation Drive Unit-**forward gear, past detent, into wide-open-throttle position.



22909

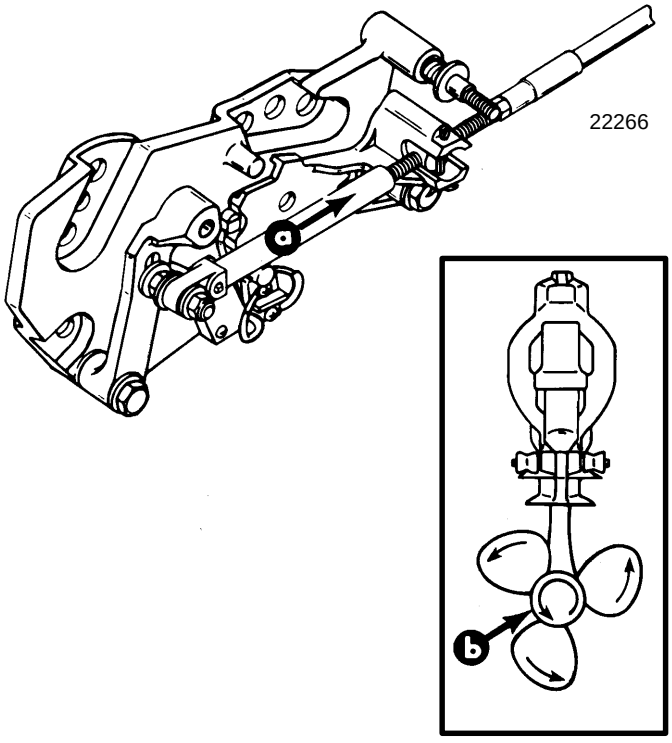
   b. **Left Hand (LH) Rotation Drive Unit-**reverse gear, past detent, into wide-open-throttle position.



22909

7. Place drive unit into gear by pushing in on drive unit shift cable, while simultaneously rotating propeller shaft counterclockwise until shaft stops, to ensure full clutch engagement. Maintain a light pressure on the drive unit shift cable to hold it at the end of its travel (this removes all slack from the cable).

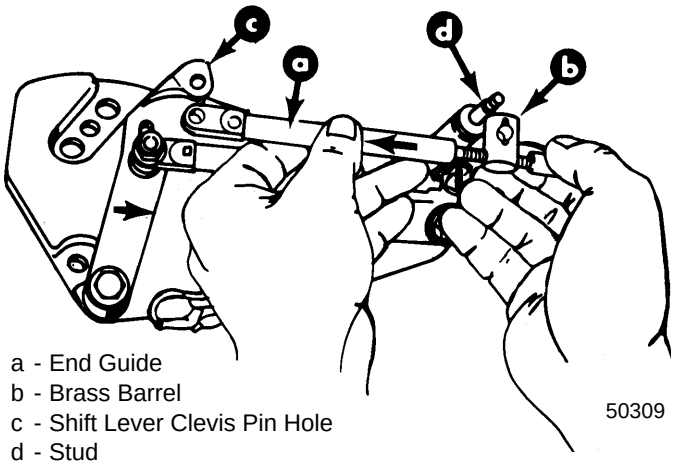
IMPORTANT: Do not use excessive force when holding pressure on the drive unit shift cable. Excessive force would be indicated by movement of the shift cutout switch.



22266

a - Drive Unit Shift Cable
b - Propeller Shaft Rotation

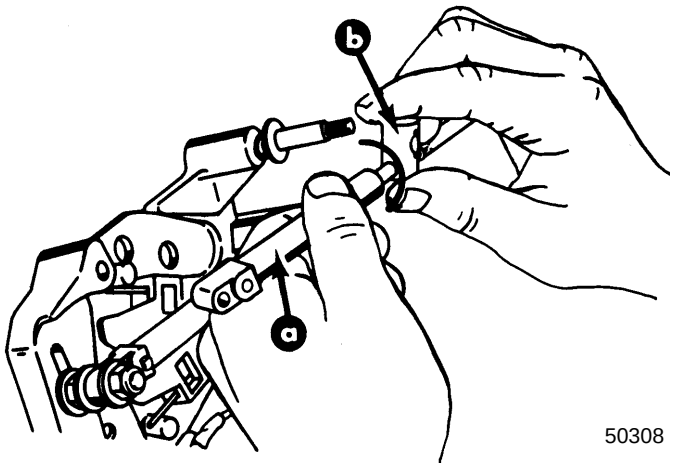
8. Lightly pull on remote control shift cable end guide (to remove slack from remote control and cable) and adjust brass barrel as necessary to align attaching points with shift lever clevis pin hole and stud. Be sure to maintain light pressure on drive unit shift cable.



50309

a - End Guide
b - Brass Barrel
c - Shift Lever Clevis Pin Hole
d - Stud

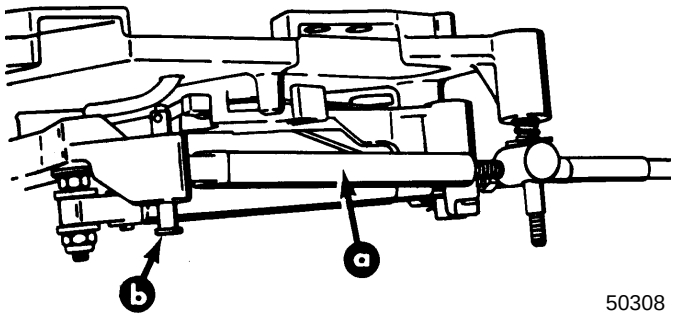
9. After cable has been aligned, turn brass barrel 4 turns **away** from cable end guide.



50308

a - End Guide
b - Brass Barrel

10. Temporarily install remote control shift cable on stud and install clevis pin.



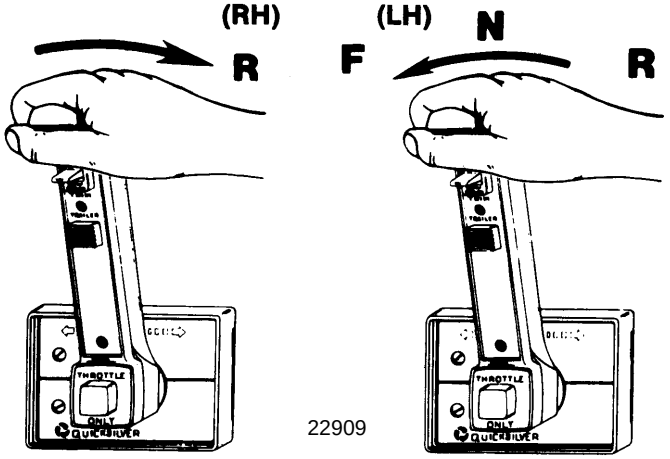
50308

a - Remote Control Shift Cable
b - Clevis Pin

11. Shift remote control as stated in “a” or “b” following:

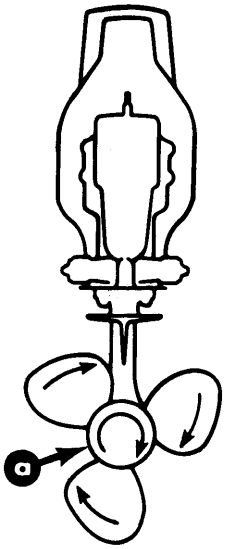
   a. **Right Hand (RH) Rotation Drive Unit -** reverse gear, past detent, into wide-open-throttle position.

   b. **Left Hand (LH) Rotation Drive Unit -** forward gear, past detent, into wide-open-throttle position.



22909

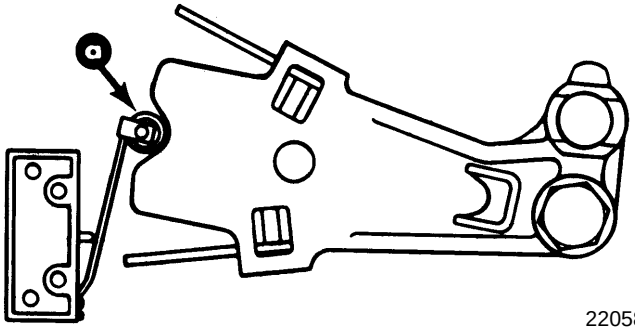
12. Simultaneously rotate propeller shaft clockwise until shaft stops to ensure full clutch engagement.



22267

a - Propeller Shaft-Rotate Clockwise

13. Check shift cutout switch lever position. Roller must be centered.



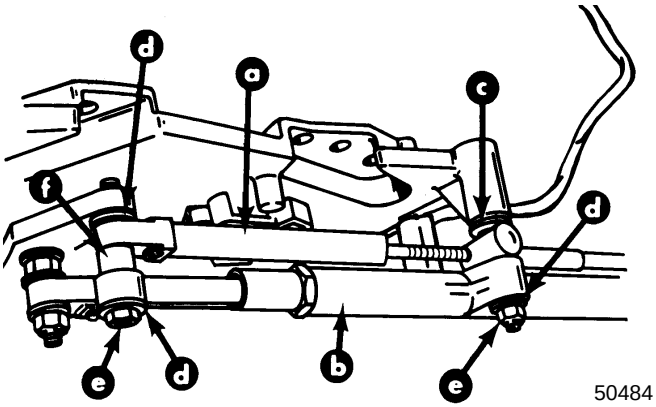
a - Shift Cutout Switch Roller

14. If roller is not centered:
    a. Ensure adjustable stud is at bottom of slot in shift lever.
    b. Check remote control for proper shift cable output [3 in. (76 mm) ± 1/8 in. (3 mm)]. Refer to “Installation Requirements.”
    c. If “a” and “b” are correct, ensure drive unit shift cable is not crushed or kinked. (If drive unit shift cable is binding, the shift cutout switch roller will move off center when shifting “into” and “out of” forward **and** reverse).

NOTE: *If shift cable was damaged during installation, install new shift cable assembly in accordance with instructions contained in sterndrive service manual, then repeat shift cable adjustment procedure.*

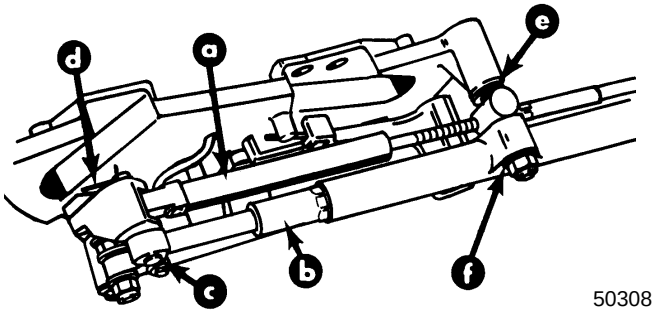
15. After remote control shift cable has been properly adjusted, reinstall cable and shift assist assembly (if applicable) and secure with hardware as shown.

    If shift assist assembly attaching points will not align, push in or pull out on end of shift assist assembly to install. Do not attempt to readjust shift cable.



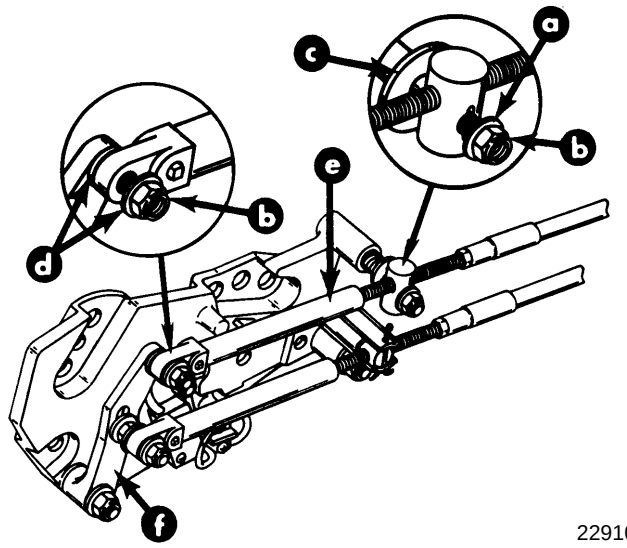
Earlier Models (With Metal Shift Lever) With Shift Assist Assembly

a - Remote Control Shift Cable
b - Shift Assist Assembly
c - Large I.D. Washer
d - Small I.D. Washer
e - Locknut-Tighten Until Bottomed then Back Off 1/2 Turn
f - Spacer



Later Models (With Plastic Shift Lever) With Shift Assist Assembly

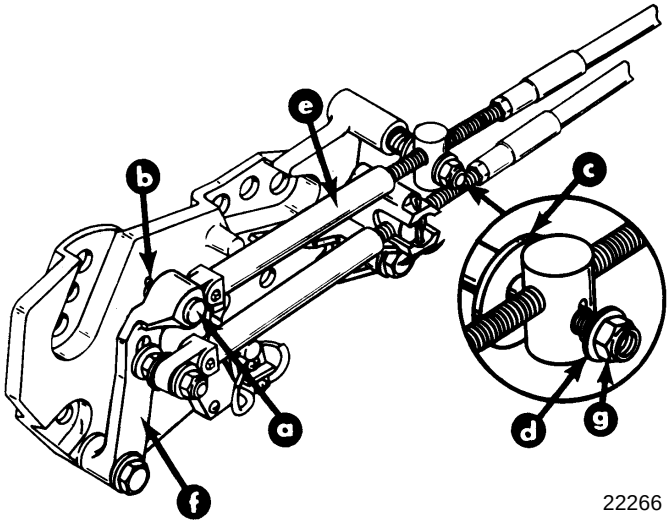
a - Remote Control Shift Cable
b - Shift Assist Assembly
c - Clevis Pin
d - Cotter Pin-(Spread Both Prongs)
e - Large I.D. Washer
f - Small I.D. Washer



22910

Earlier Models (With Metal Shift Lever) Without Shift Assist Assembly

a - Washer (Same Size I.D.)
b - Locknut
c - Washer (Large I.D.)
d - Washers (Small I.D.) (2)
e - Cable End Guide
f - Shift Lever



22266

Later Models (With Plastic Shift Lever) Without Shift Assist Assembly

a - Pin
b - Cotter Pin
c - Washer (Large I.D.)
d - Washer (Small I.D.)
e - Cable End Guide
f - Shift Lever
g - Locknut

IMPORTANT: If an extra long remote control shift cable is used, or if there are a large number of bends in remote control shift cable, or remote control has inadequate output travel, an additional adjustment may be necessary. Refer to step 15 or 16 as applicable.

16. **Remote Control with Single Lever Shift/ Throttle Control:**

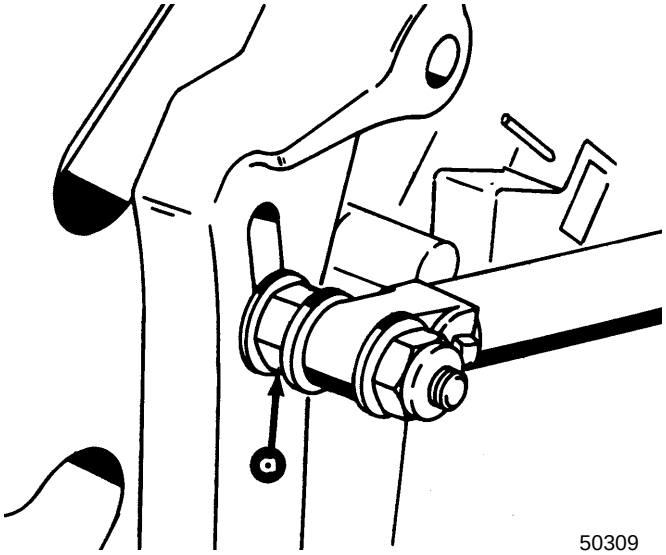
    a. **RIGHT HAND (RH) propeller rotation drive unit-**Shift remote control into reverse gear, wide open throttle position while simultaneously rotating propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with reverse gear. Retighten stud. Shift remote control several times and stop in reverse to recheck shift cutout switch position. Roller must be centered.

    b. **LEFT HAND (LH) propeller rotation drive unit-**Shift remote control into forward gear, wide open throttle position while simultaneously rotating propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with forward gear. Retighten stud. Shift remote control several times and stop in forward to recheck shift cutout switch position. Roller must be centered.

17. **Two Lever Remote Control with Separate Shift and Throttle Levers:**

    a. **RIGHT HAND (RH) propeller rotation drive unit-**While turning propeller shaft clockwise, move remote control shift handle into full reverse position. Clutch should engage before shift lever comes to a stop. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with reverse gear. Retighten stud. Shift remote control several times and stop in reverse to recheck shift cutout switch position. Roller must be centered.

    b. **LEFT HAND (LH) propeller rotation drive unit-**While turning propeller shaft clockwise, move remote control shift handle into full forward position. Clutch should engage before shift lever comes to a stop. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with forward gear. Retighten stud. Shift remote control several times and stop in forward to recheck shift cutout switch position. Roller must be centered.



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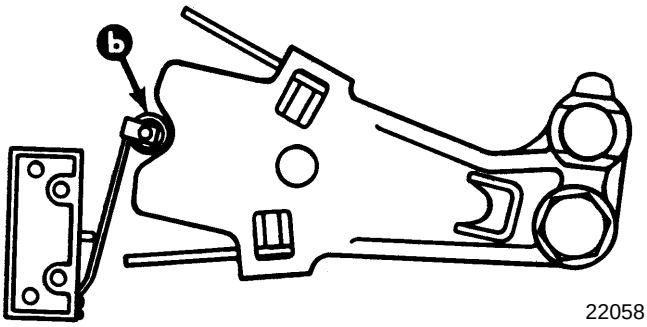


22058

a - Adjustable Stud
b - Shift Cutout Switch Roller

18. Place boat in water and start engine. Check the following:
    a. Shift into forward and reverse gear, making sure that clutch engages before engine begins to accelerate.
    b. Accelerate engine in forward and reverse gear to ensure engine does not shut down.
    c. Check that shift cutout switch roller is centered in notch of shift cutout lever, with drive unit in forward and reverse gear.
    d. Shifting from “in gear position” to neutral, ensure drive unit is in neutral before remote control shift lever comes to neutral detent position.

Propeller Installation

⚠WARNING

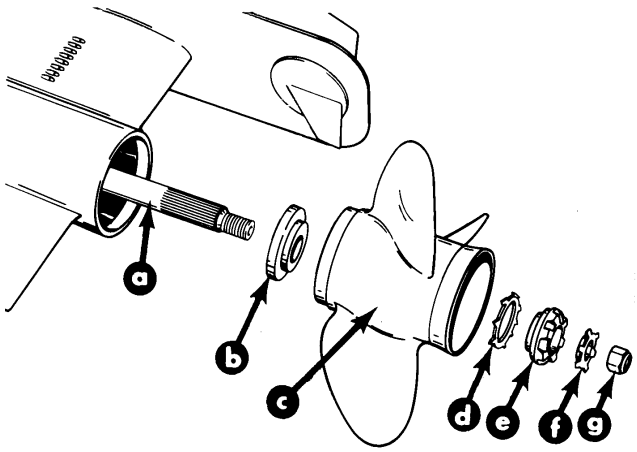
Be sure that remote control is in neutral position and ignition key is removed from switch.

⚠WARNING

Place a block of wood between the anti-ventilation plate and propeller to protect hands from propeller blades and to prevent propeller from turning.

1. To aid in future propeller removal, liberally coat the propeller shaft splines with one of the following lubricants. Install propeller as shown.
    - Special Lubricant 101
    - 2-4-C Marine Lubricant
    - Perfect Seal

IMPORTANT: Installation is correct when at least 2 threads of propeller shaft are exposed through propeller nut.



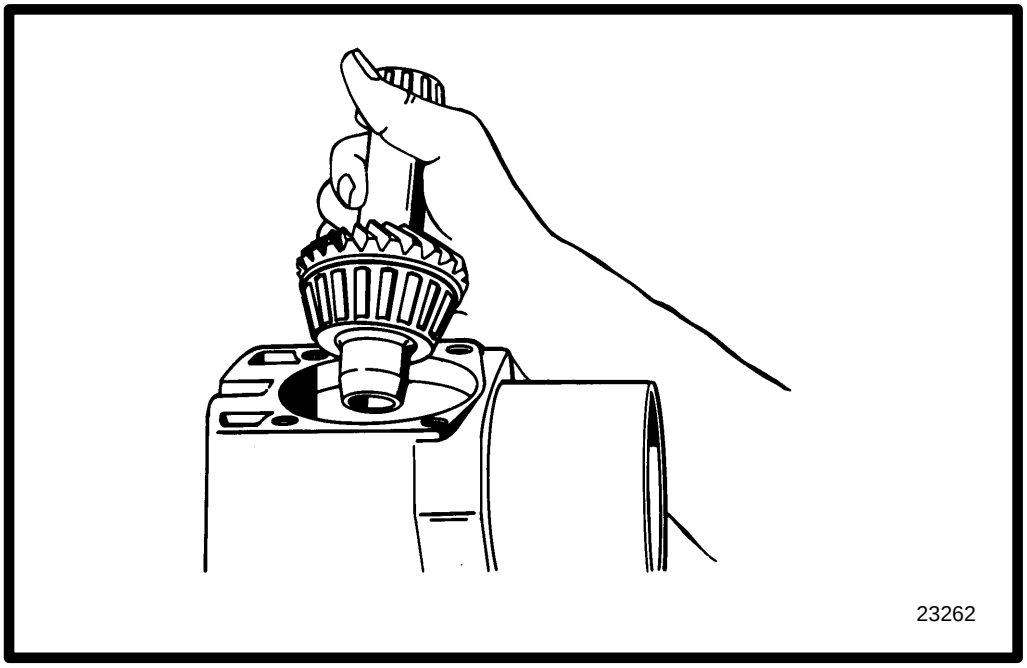
22074

a - Propeller Shaft
b - Forward Thrust Hub
c - Propeller
d - Continuity Washer
e - Spline Washer
f - Tab Washer
g - Propeller Nut

2. Tighten propeller nut until a torque of 55 lb. ft. (75 N·m) is obtained and continue until 3 tabs on tab washer align with grooves on spline washer. Bend tabs into spline washer.

STERNDRIVE UNIT

3
A



DRIVE SHAFT HOUSING

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Specifications

Torque Specifications

NOTE: *Listed below are the torque specifications for those fasteners which have a specific torque value. Tighten all other fasteners (not listed) securely.*

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Top Cover Screws		17-23	23-31
U-joint Retainer Nut		200	271
U-joint Drive Gear Nut		70-80	95-108
Water Pocket Cover Screws	30-40		3-4
Oil Vent Screw	30-50		3-6

Upper Drive Shaft Bearing Preload

DESCRIPTION	TORQUE	
	lb. in.	N·m
New Bearings	6-10	0.7-1
Used Bearings*	2.5-4	0.3-0.45

*Bearings are considered used if spun under load once.

Gear Shimming Specifications

DESCRIPTION	GEAR LOCATION	
	inches	millimeters
Drive Gear Height (Gears Marked “G-7”)	.32	0.8
Drive Gear Height (All Others)	.025	0.64
Driven Gear Height	.025	0.64

Lubricants/Sealers/ Adhesives

Description	Part No.
Quicksilver 2-4-C Marine Lubricant	92-825407A2
Quicksilver Special Lubricant 101	92-13872A1
Engine Coupler Spline Grease	92-816391A4
Quicksilver High Performance Gear Lube	92-816026A1
Loctite 27131	92-809820
Perfect Seal	92-34227--1

Special Tools

Description	Part No.
Adaptor	91-38756
Engine Alignment Tool	91-57797A3
Alignment Tool Assembly	91-805475A1
Bearing Cup Driver	91-38918
Bearing Driver Cup	91-33493
Oil Seal Driver	91-43591
Shimming Tool (Driven Gear)	91-60526
Shimming Tool (Drive Gear)	91-60523
Slide Hammer Puller	91-34569A1
Torque Wrench (lb. in.)	91-66274
U-joint Bearing Retainer Wrench	91-17256
Universal Puller Plate	91-37241

Overall Gear Ratios with 17/28 Lower Gears

R/MR Models

Model	1.32:1 (Drive/Driven) 20/16	1.50:1 22/20	1.65:1 24/24	1.84:1 17/19	1.98:1 20/24	2.40:1 20/24
120R					S	H[1]
120MR					S	H[1]
140R					S	H[1]
140MR					S	H[1]
170MR			O	S	O	
185R			O	S	O	
185MR			O	S	O	
190MR			O	S	O	
200MR		O	S	O	O	
205MR		O	S	O	O	
228R		S	O	O		
230MR		S	O	O		
260R	S[2]	S	O	O		
260MR		S	O	O		
300MR		S	O	O		
470R			O	S	O	
488R			O	S	O	
898R		S	S[3]	O		

S: Standard
O: Optional
H: High Elevation Only

[1]: Ratio Changed in Gear Housing must be changed by dealer-not a factory option
[2]: Some Models This Ratio Standard
[3]: Newer Models This Ratio Standard

Overall Gear Ratios When Serviced with 13/21 Lower Gears

R/MR Models

Model	1.29:1 (Drive/Driven) 20/16	1.47:1 22/20	1.62:1 24/24	1.81:1 17/19	1.94:1 20/24	2.40:1 20/24
120R					S	H[1]
120MR					S	H[1]
140R					S	H[1]
140MR					S	H[1]
170MR			O	S	O	
185R			O	S	O	
185MR			O	S	O	
190MR			O	S	O	
200MR		O	S	O	O	
205MR		O	S	O	O	
228R		S	O	O		
230MR		S	O	O		
260R	S[2]	S	O	O		
260MR		S	O	O		
300MR		S	O	O		
470R			O	S	O	
488R			O	S	O	
898R		S	S[3]	O		

S: Standard
O: Optional
H: High Elevation Only

[1]: Ratio Changed in Gear Housing must be changed by dealer-not a factory option
[2]: Some Models This Ratio Standard
[3]: Newer Models This Ratio Standard

Overall Gear Ratio with 17/28 Lower Gears

Alpha One / Alpha One SS Models

Model	1.32:1 (Drive/Driven) 20/16	1.50:1 22/20	1.65:1 24/24	1.84:1 17/19	1.98:1 20/24	2.40:1 20/24
120 Alpha One					S	H[1]
140 Alpha One					S	H[1]
165 Alpha One			O	S	O	
170 Alpha One			O	S	O	
175 Alpha One			O	S	O	
180 Alpha One			O	S	O	
185 Alpha One			O	S	O	
190 Alpha One			O	S	O	
200 Alpha One		O	S	O		
205 Alpha One			O	S	O	
230 Alpha One		S	O	O		
260 Alpha One		S	O	O		
300 (Tempest) Alpha One		S	O	O		
320 EFI Alpha One		S[2]				
320 EFI Alpha One SS		S[2]				
350 Magnum Alpha One		S[3,4]				
454 Magnum Alpha One	S					
454 Magnum Alpha One SS	S					
2.5 Litre Alpha One					S	H[1]
3.0 Litre Alpha One					S	H[1]
3.7 Litre Alpha One			O	S	O	
3.7 LX Alpha One			O	S	O	
4.3 Litre Alpha One			O	S	O	
4.3 LX Alpha One			O	S	O	
5.0 Litre Alpha One		O	S	O		
5.0 LX Alpha One		S[3]	O	O		
5.7 Litre Alpha One		S[3]	O	O		

S: Standard
O: Optional
H: High Elevation Only

[1]: Ratio Changed in Gear Housing must be changed by dealer-not a factory option

[2]: Use 1.5:1 Heavy Duty Gears P/N 43-14010A1 set (320 EFI Only)

[3]: Drive Shaft Housing Gears P/N 43-18410A2 Gear set is replacement for P/N 43-59832A2 gear set

[4]: Use Replacement Lower Gear Housing Gears P/N 43-17064A3 (Propeller shaft identified with letter “M”)

Overall Gear Ratio When Serviced with 13/21 Lower Gears

Alpha One / Alpha One SS Models

Model	1.32:1 (Drive/Driven) 20/16	1.50:1 22/20	1.65:1 24/24	1.84:1 17/19	1.98:1 20/24	2.40:1 20/24
120 Alpha One					S	H[1]
140 Alpha One					S	H[1]
165 Alpha One			O	S	O	
170 Alpha One			O	S	O	
175 Alpha One			O	S	O	
180 Alpha One			O	S	O	
185 Alpha One			O	S	O	
190 Alpha One			O	S	O	
200 Alpha One		O	S	O		
205 Alpha One			O	S	O	
230 Alpha One		S	O	O		
260 Alpha One		S	O	O		
300 (Tempest) Alpha One		S	O	O		
320 EFI Alpha One		S[2]				
320 EFI Alpha One SS		S[2]				
350 Magnum Alpha One		S[3,4]				
454 Magnum Alpha One	S					
454 Magnum Alpha One SS	S					
2.5 Litre Alpha One					S	H[1]
3.0 Litre Alpha One					S	H[1]
3.7 Litre Alpha One			O	S	O	
3.7 LX Alpha One			O	S	O	
4.3 Litre Alpha One			O	S	O	
4.3 LX Alpha One			O	S	O	
5.0 Litre Alpha One		O	S	O		
5.0 LX Alpha One		S[3]	O	O		
5.7 Litre Alpha One		S[3]	O	O		

S: Standard
O: Optional
H: High Elevation Only

[1]: Ratio Changed in Gear Housing must be changed by dealer-not a factory option

[2]: Use 1.5:1 Heavy Duty Gears P/N 43-14010A1 set (320 EFI Only)

[3]: Drive Shaft Housing Gears P/N 43-18410A2 Gear set is replacement for P/N 43-59832A2 gear set

[4]: Use Replacement Lower Gear Housing Gears P/N 43-17064A3 (Propeller shaft identified with letter “M”)

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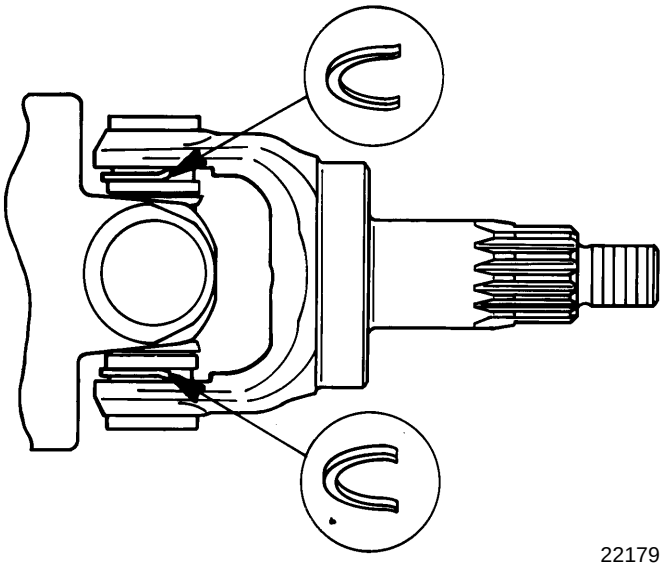
Special Information

C-Ring Kit To Eliminate U-Joint Knocking

If you encounter a MerCruiser I-R/I-MR sterndrive with a U-joint knocking or vibrating problem when turning or trimming, the problem may be caused by excessive side-to-side play in the U-joint cross and bearing assemblies. Replace standard cross and bearing assembly C-rings with C-ring Kit 53-12067A1. Kit contains 8 C-rings, which is enough for 1 drive unit. C-rings are curved at the ends and must be installed with the curve toward the yoke or center socket. Be sure C-rings are seated in grooves.

IMPORTANT: New C-rings can be used with original cross and bearing assemblies only. C-rings cannot be used with service replacement Spicer cross and bearing assembly 41431 as grooves in bearing caps are too narrow.

C-ring Kit 53-12067A1

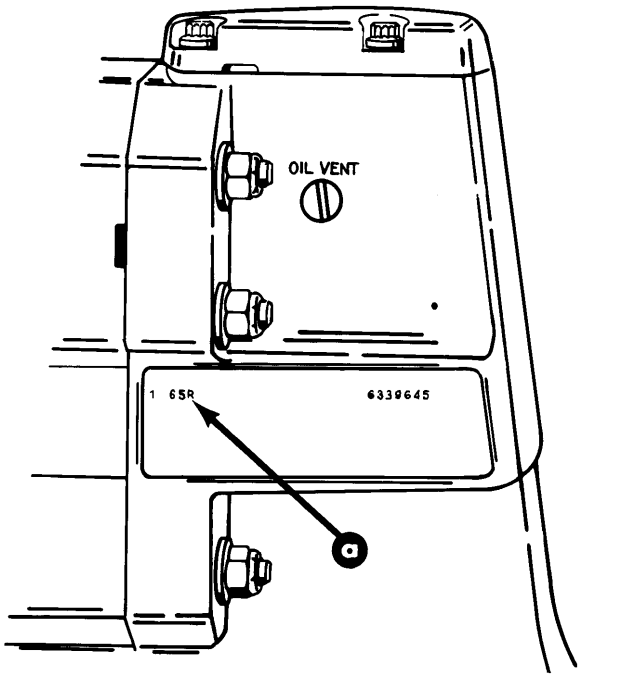


22179

C-ring Installation

Remarking Mercruiser IR-IMR Sterndrive Units After Gear Ratio Conversion

MerCruiser IR-IMR sterndrive units have the gear ratio stamped into the decal on the drive shaft housing. Should it be necessary to convert one of these units to a different gear ratio, be sure to mark the decal with the appropriate ratio. The customer also should be advised as to what gear ratio his unit is equipped with.



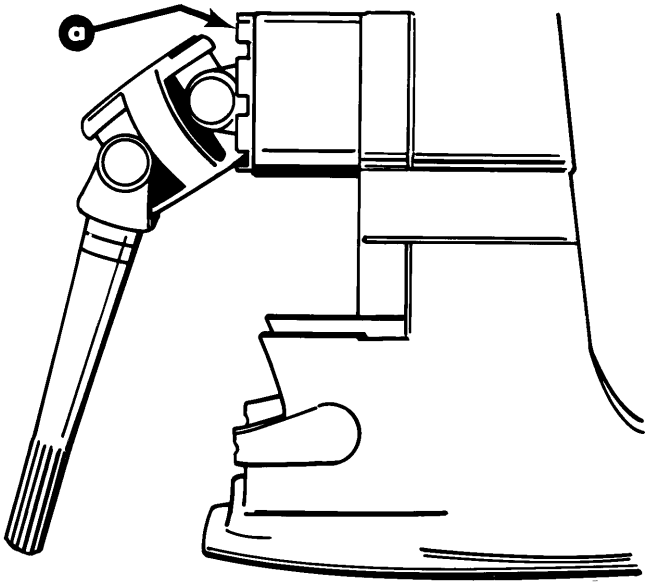
23263

Sterndrive Unit Gear Ratio Location

a - Gear Ratio

Torquing U-joint Bearing Retainer

1. Torque U-joint bearing retainer to 200 lb. ft. (271 N·m). Use the following procedure to allow torquing retainer with a torque wrench.



22061

U-joint Bearing Retainer

a - Retainer

   a. Use Bearing Retainer Wrench 91-17256.

   b. Measure length of torque wrench as follows:

      On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.

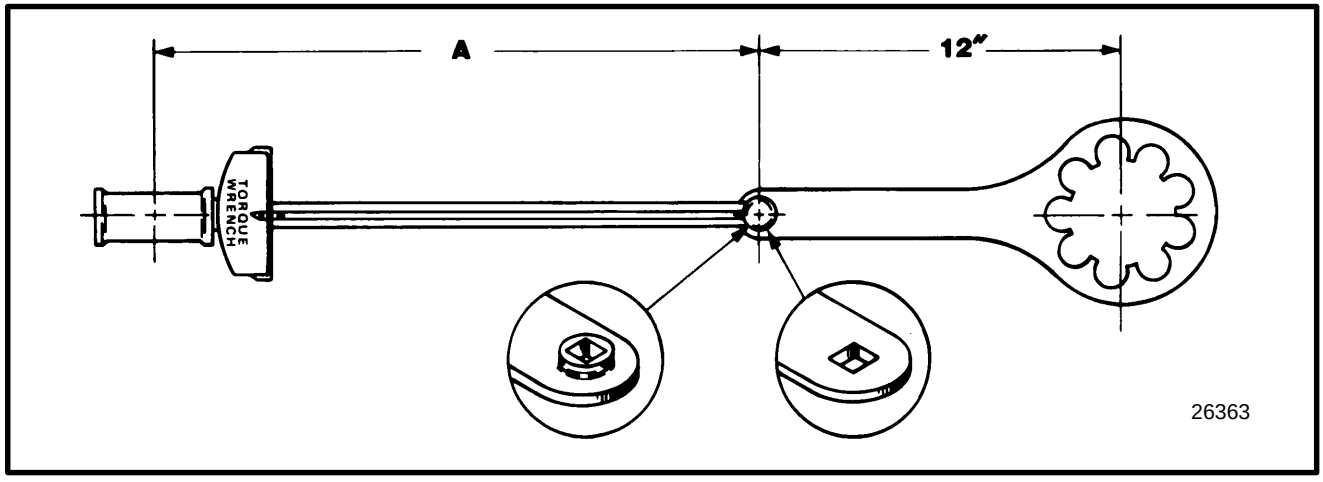
      On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (2 bands, etc.).

2. Torque wrench reading will be less than actual torque being applied to retainer, due to torque reading being taken through retainer wrench. Use the following chart to determine torque wrench reading required to properly torque retainer.

TORQUE CONVERSION CHART

Torque Wrench Length in Inches (cm)	Torque Wrench Reading in Lb. Ft. (N·m)
15 (38)	111 (151)
16 (41)	114 (155)
17 (43)	117 (159)
18 (46)	120 (163)
19 (48)	123 (167)
20 (51)	125 (170)
21 (53)	127 (172)
22 (56)	129 (175)
23 (58)	131 (178)
24 (61)	133 (180)
25 (64)	135 (183)
26 (66)	136 (184)
27 (69)	138 (187)
28 (71)	140 (190)
29 (74)	141 (191)
30 (76)	143 (194)
31 (79)	144 (195)
32 (81)	145 (197)
33 (84)	147 (200)
34 (86)	148 (201)
35 (89)	149 (202)
36 (91)	150 (203)

3. Torque retainer until prescribed reading is attained on torque wrench.



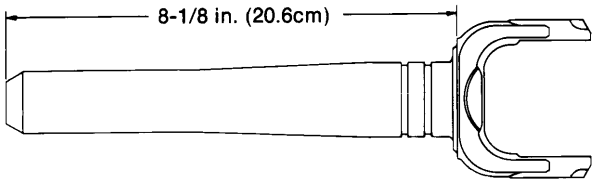
26363

Machining Square in Retainer Wrench 91-36235

a - Torque Wrench Length

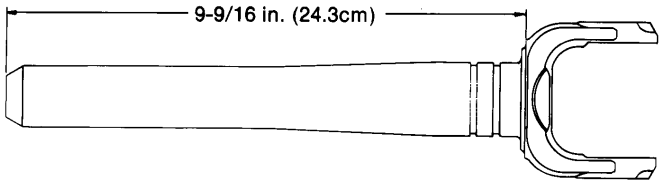
Use Of Older Model Sterndrive Units On Mercruiser IR-IMR Models

Mercury Marine does not recommend the use of older model sterndrive units on IR-IMR models, as the units will not mate up satisfactorily with the transom assembly. In addition, the older in-line model sterndrive units are equipped with U-joint coupling end yoke (39385A1). This yoke is shorter than yoke (59830A1) used on the IR-IMR sterndrive units and therefore, will not fully engage the engine coupler splines. USE OF AN OLDER IN-LINE MODEL STERNDRIVE UNIT ON A IR-IMR MODEL WILL RESULT IN A SPLINE FAILURE TO COUPLING AND/OR YOKE.



26363

U-joint Coupling End Yoke (39385A1) Used On Older In-Line Models



26363

U-joint Coupling End Yoke (59830A1) Used On MerCruiser IR-IMR Models

Drive Unit Gear Ratio Identification

All drive unit gear ratios are identified on each drive in two places. It is important to note the ratio of the drive unit before proceeding with any repairs. The first place to look is on the decal on the port side of the drive housing. It will have a number such as (1.50R) and then the seal number. The second place to look will be on the universal joint splined yoke. It will be identified with a letter such as (F). This method is explained in the following chart.

ALPHA

B = 1.98:1 & 1.94:1
C = 1.65:1 & 1.62:1
D = 1.84:1 & 1.81:1
F = 1.50:1 & 1.47:1
H = 1.32:1 & 1.29:1
M = 1.50:1 & 1.47:1 MAGNUM

This will be true for new drive units or drive units that have not been serviced. A drive unit could have had the gear ratio changed for high altitude or had the lower unit gears changed to a more recent version, which would void out any application of the above chart. The gear ratio would then have to be determined by counting the teeth on the drive gear and the driven gear in the drive shaft housing and using the following chart for reference.

	ALPHA	
Ratio	**Drive**	**Driven**
1.98:1 & 1.94:1	20	24
1.84:1 & 1.81:1	17	19
1.65:1 & 1.62:1	24	24
1.50:1 & 1.47:1	20	22
1.32:1 & 1.29:1	20	16

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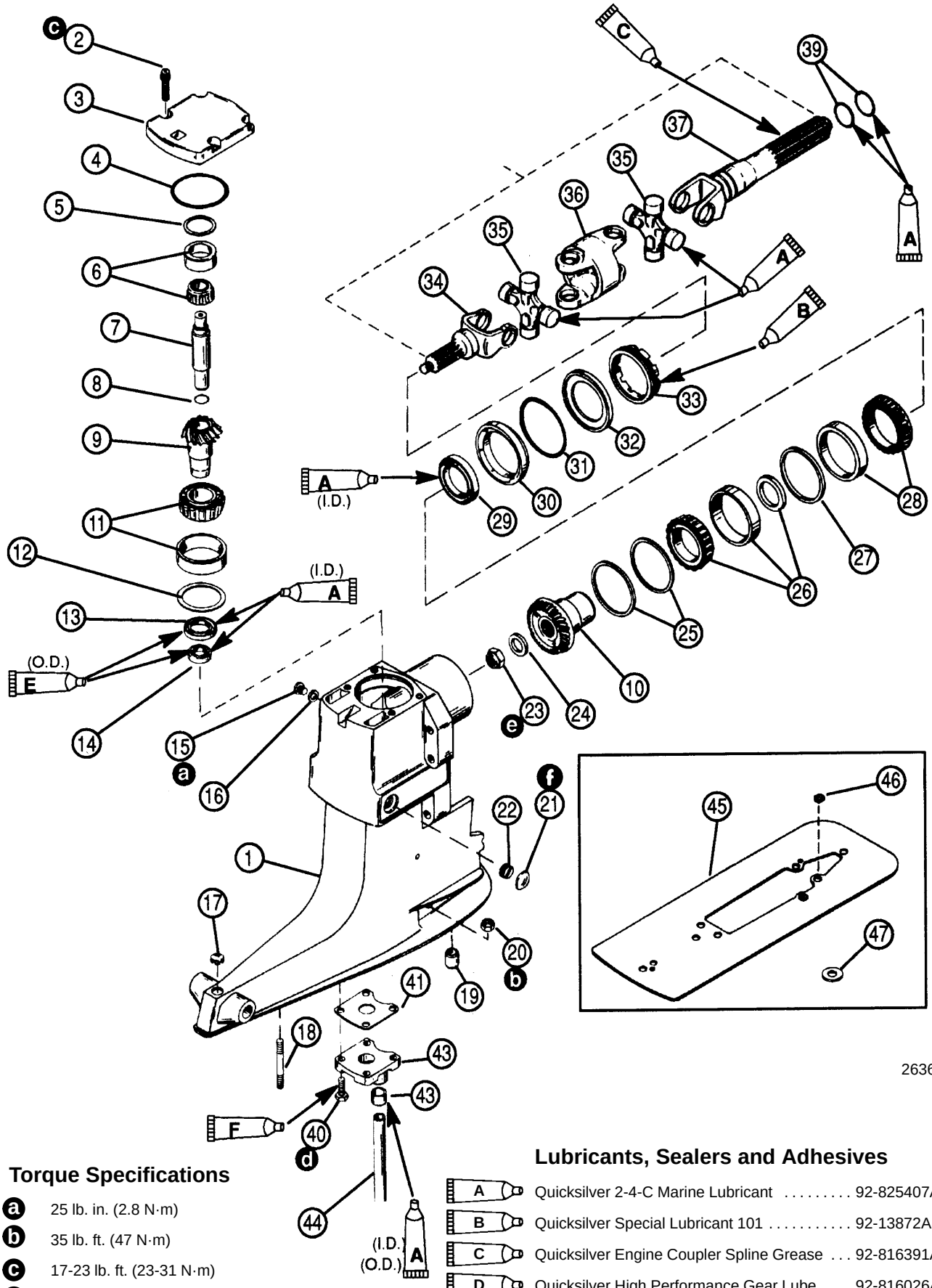

Torque Specifications

- a 25 lb. in. (2.8 N·m)
- b 35 lb. ft. (47 N·m)
- c 17-23 lb. ft. (23-31 N·m)
- d 30-40 lb. in. (3-4 N·m)
- e 70-80 lb. ft. (95-108 N·m)
- f 30-50 lb. in. (3.4-5.7 N·m)

Lubricants, Sealers and Adhesives

A	Quicksilver 2-4-C Marine Lubricant	92-825407A2
B	Quicksilver Special Lubricant 101	92-13872A1
C	Quicksilver Engine Coupler Spline Grease	92-816391A4
D	Quicksilver High Performance Gear Lube	92-816026A1
E	Quicksilver Loctite 27131	92-809820
F	Quicksilver Perfect Seal	92-34227 1

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Drive Shaft Housing Exploded View

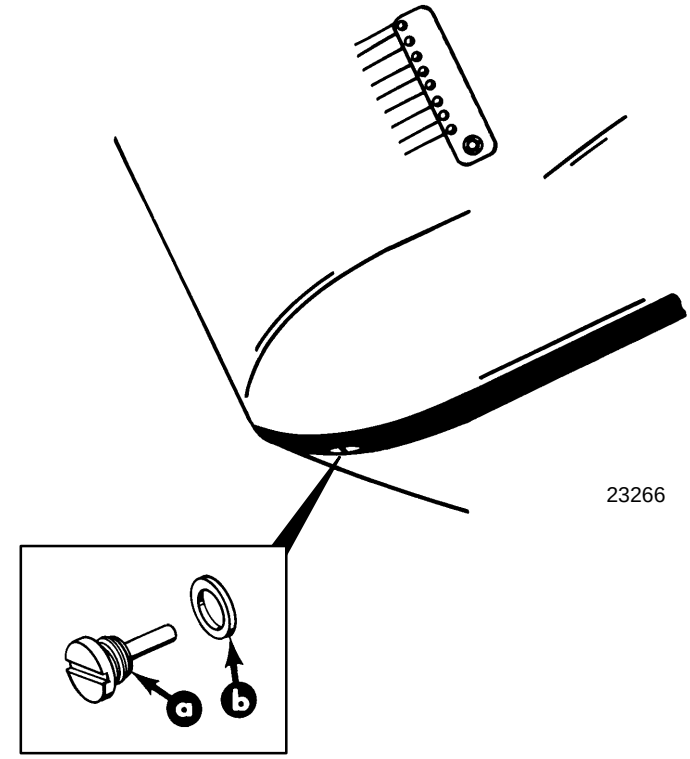
1 - Drive Shaft Housing
2 - Screw, Top Cover (4)
3 - Top Cover
4 - O-ring, Top Cover
5 - Shim, Bearing Cup To Top Cover
6 - Bearing Assembly, Drive Shaft
7 - Upper Drive Shaft
8 - O-ring, Upper Drive Shaft
9 - Driven Gear
10- Drive Gear
11- Roller Bearing Assembly, Driven Gear
12- Shim, Drive Gear Bearing Cup
13- Oil Seal, Upper-Drive Shaft Housing
14- Oil Seal, Lower-Drive Shaft Housing
15- Vent Screw
16- Sealing Washer, Vent Screw
17- Plug, Trim Tab Hole
18- Stud, Drive Shaft Housing (4)
19- Bushing, Drive Shaft Housing
20- Nut, Gear Housing Stud (3)
21- Welch Plug, Drive Shaft Housing
22- Pipe Plug, Water Pocket
23- Nut, Drive Gear To U-joint
24- Washer, Drive Gear To U-joint Nut
25- Shim, Bearing Cup
26- Roller Bearing Assembly, Drive Gear-Note 1
27- Spacer, Roller Bearing Cups
28- Roller Bearing Assembly, Drive Gear
29- Oil Seal, Carrier Assembly
30- Carrier Assembly, Oil Seal
31- O-ring, Oil Seal Carrier Assembly
32- Ring, Roller Bearing Retainer
33- Retainer
34- Yoke, U-joint-Gear End
35- Cross And Bearing Assembly, U-joint
36- Socket, Center U-joint
37- Yoke Assembly, U-joint-Coupling End
38- U-joint Assembly
39- O-ring, U-joint
40- Screw, Water Pocket Cover To Drive Shaft Housing (4)
41- Gasket, Water Pocket Cover
42- Water Pocket Cover
43- Seal, Rubber-Water Pocket Cover
44- Water Tube, Water Pocket Cover
45- Splash Plate Kit
46- Seal, Splash Plate Kit
47- Washer, Splash Plate Kit

NOTE 1: This item will not be included in Later Model units or when ordering the following gear sets:

43-18411A2
43-45814A5
43-55778A3
43-75325A3

Drive Shaft Housing and Gear Housing Separation

1. Tilt drive unit at a 45 degree angle, remove fill/drain screw then remove drive shaft housing vent screw. Allow drive unit to drain completely.



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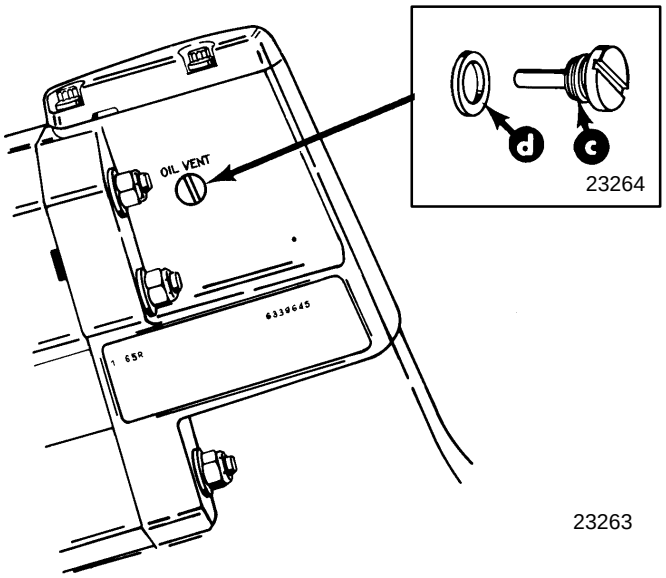
a - Fill/Drain Screw
b - Sealing Washer



23264

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c - Vent Screw
d - Sealing Washer

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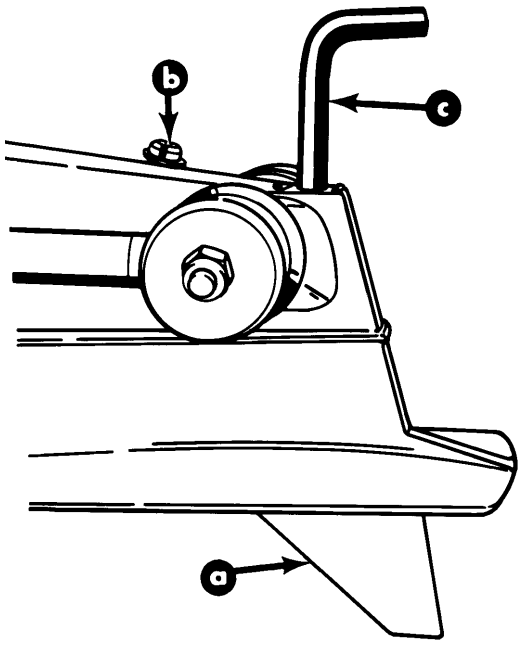
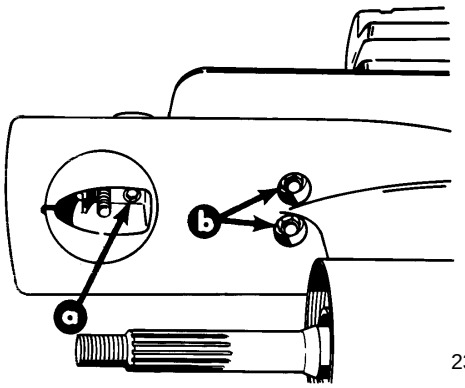
2. Mark position of trim tab with a piece of tape. Remove trim tab.



23253

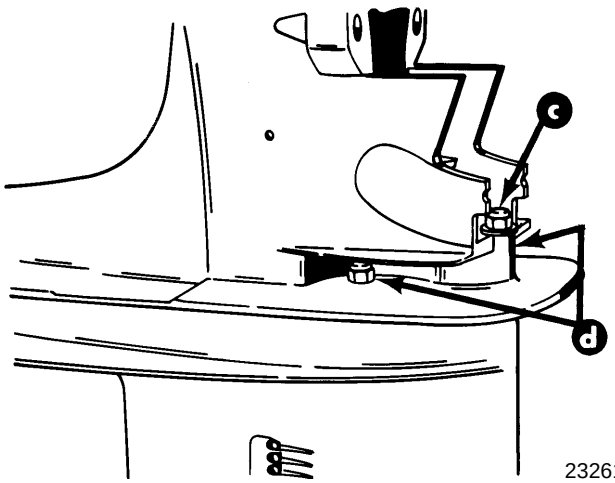
a - Trim Tab
b - Plastic Plug
c - 3/8 in. Hex Wrench

3. Remove gear housing from drive shaft housing.



23263

a - Hex Screw (Allen Screw)
b - Locknuts

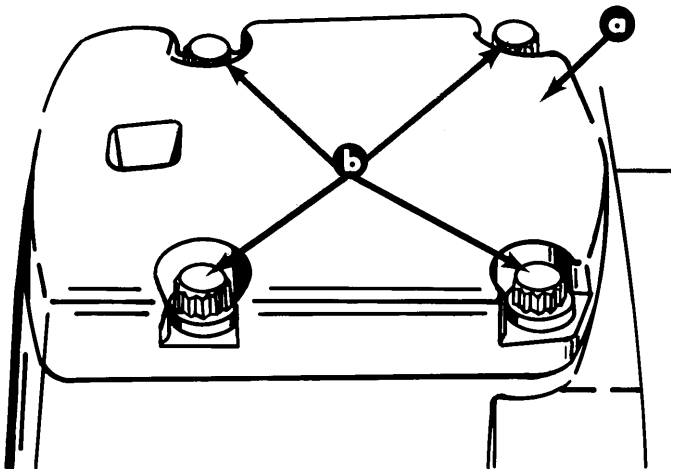


23261

c - Locknut (1)
d - Locknut (2)-One each side

Drive Shaft Housing Disassembly

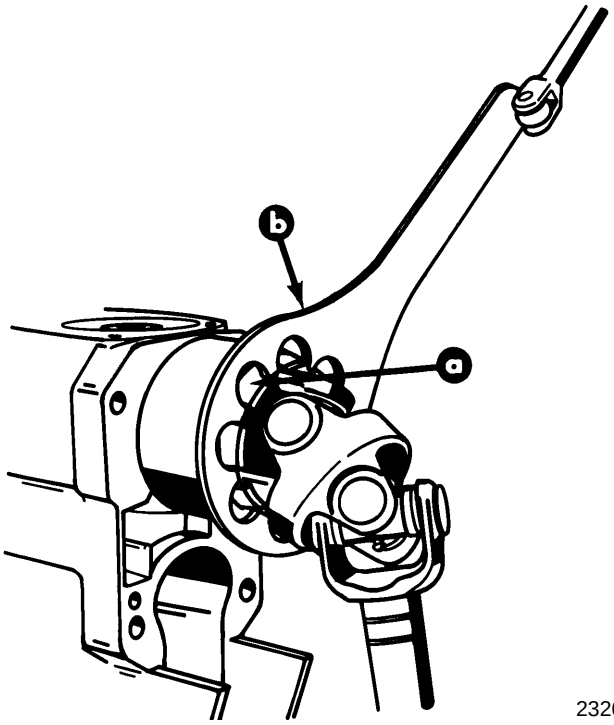
1. Remove top cover.



23261

a - Top Cover
b - Screws (4)

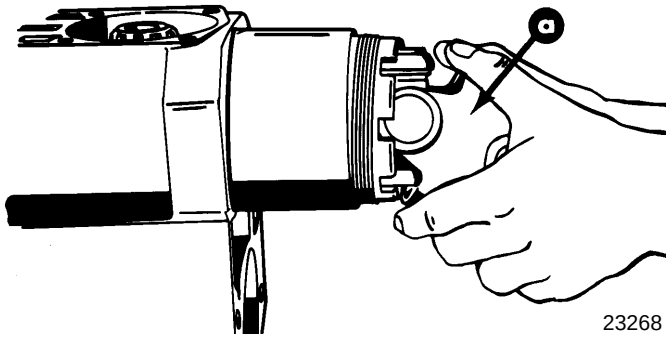
2. Loosen bearing retainer.



23268

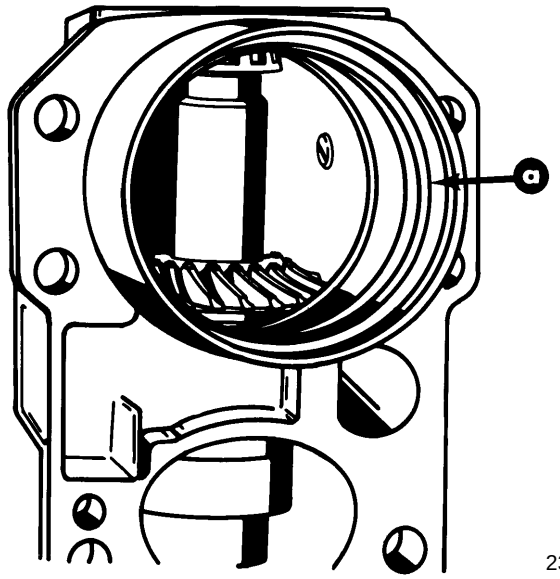
a - Bearing Retainer
b - Bearing Retainer Wrench (P/N 91-17256)

3. Remove U-joint Assembly by pulling straight out.



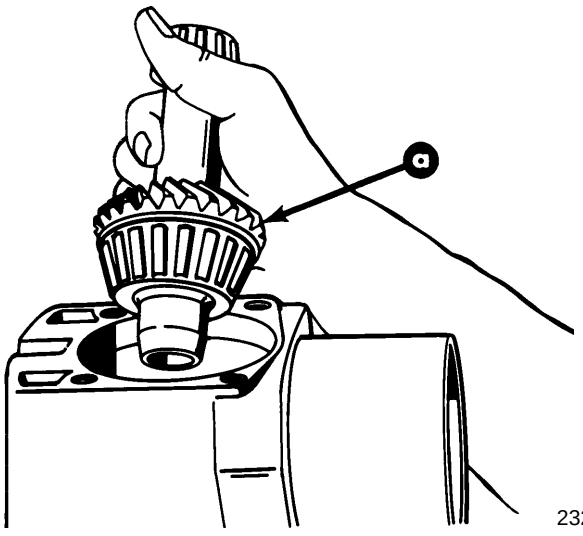
a - U-joint Assembly

4. Remove and retain shims.



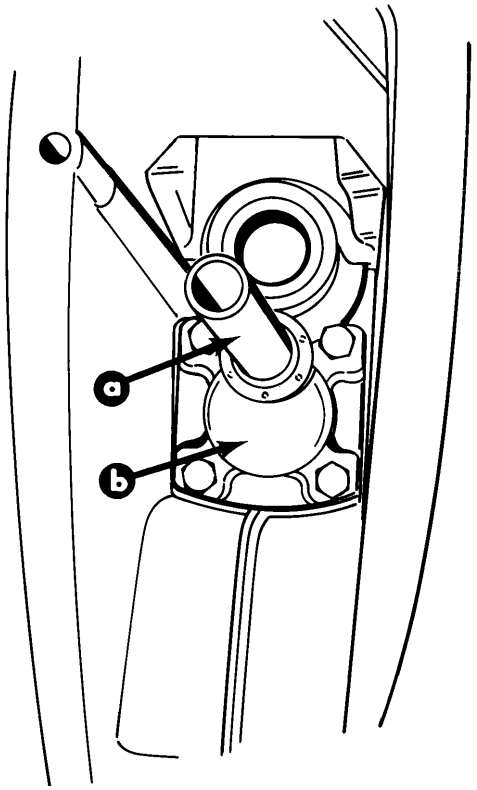
a - Shims

5. Remove upper drive shaft and driven gear assembly.



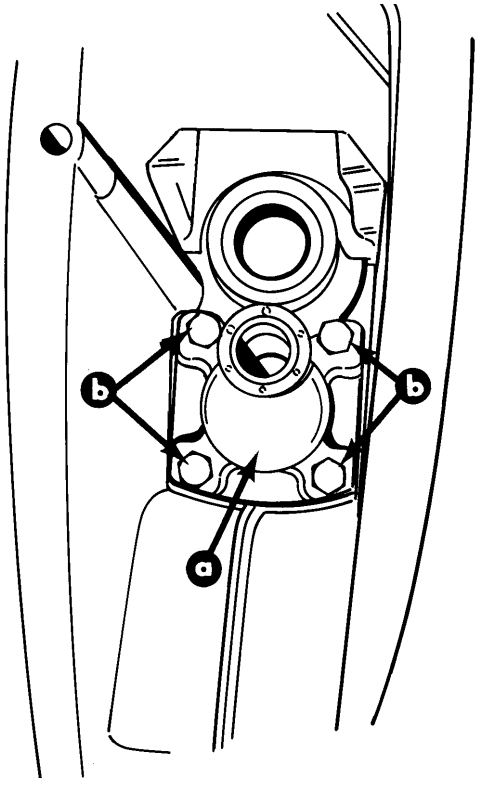
a - Upper Drive Shaft And Driven Gear Assembly

6. Remove water tube from water pocket cover.



a - Water Tube (Copper)
b - Water Pocket Cover

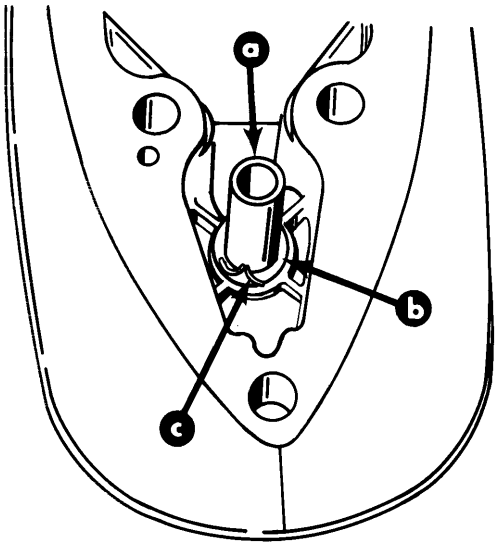
7. Remove water pocket cover and gasket.



a - Water Pocket Cover (Gasket Beneath)
b - Screws (4)

Index

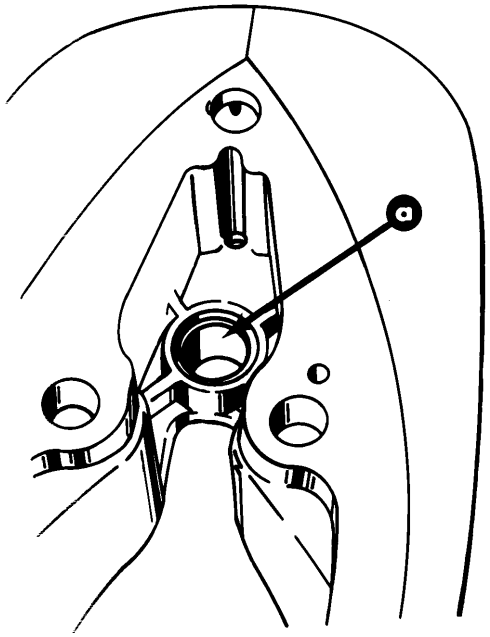
8. Remove intermediate shift shaft.



23261

a - Intermediate Shift Shaft
b - Flat Washer
c - Cotter Pin

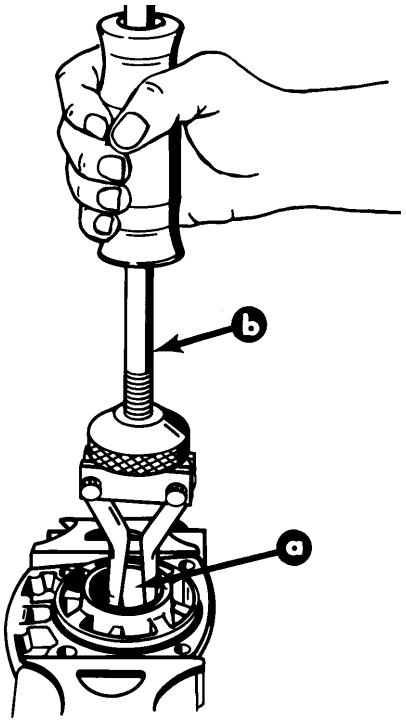
9. Remove intermediate shift shaft bushing with a suitable mandrel (earlier models only). Discard the bushing on Alpha I, SS model drive units.



23261

a - Bushing

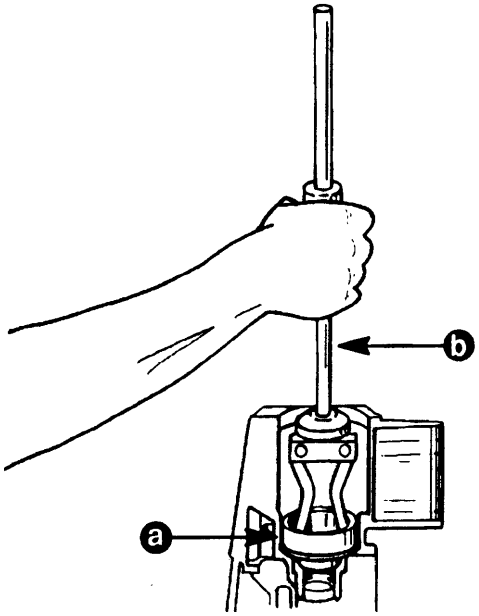
10. Remove top cover bearing cup and shims.



23263

a - Bearing Cup (Shims Underneath)
b - Slide Hammer Puller (P/N 91-34569A1)

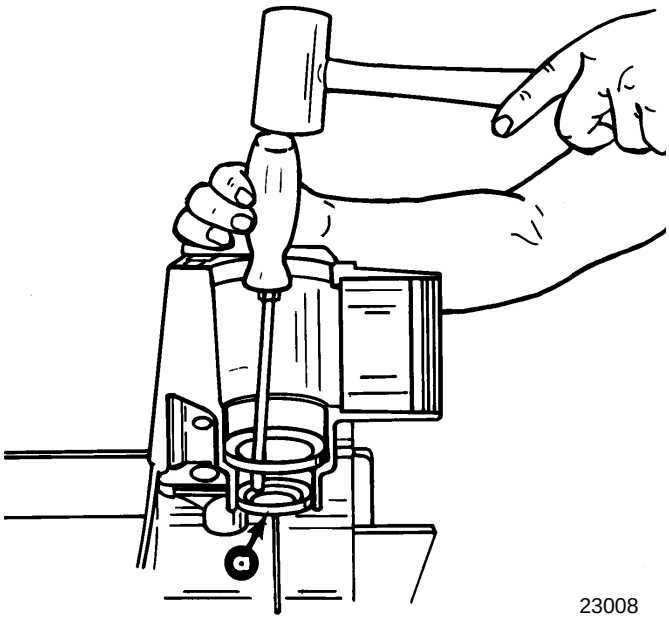
11. Remove driven gear bearing cup and shims.



23007

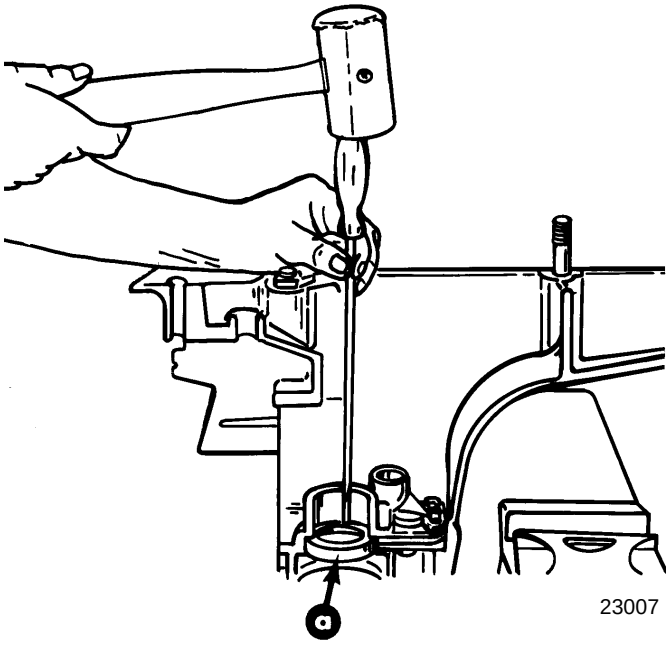
a - Bearing Cup (Shims Underneath)
b - Slide Hammer Puller (91-34569A1)

12. Remove drive shaft housing lower oil seal.



a - Oil Seal

13. Remove drive shaft housing upper oil seal.



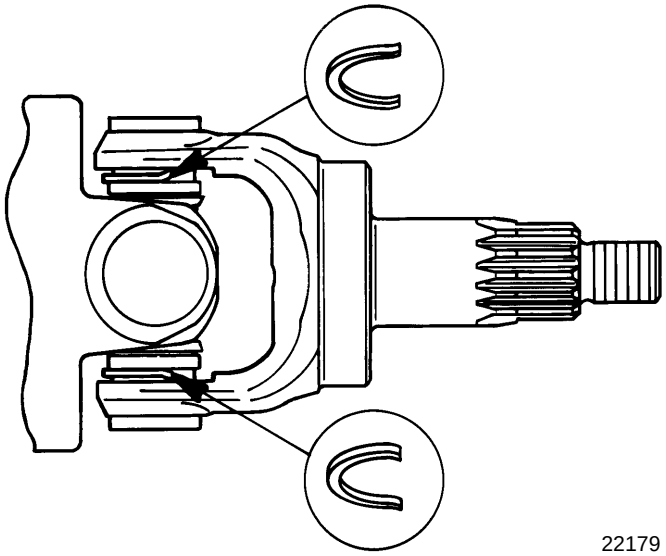
a - Oil Seal

U-joint Assembly Servicing

Pre-Disassembly Inspection

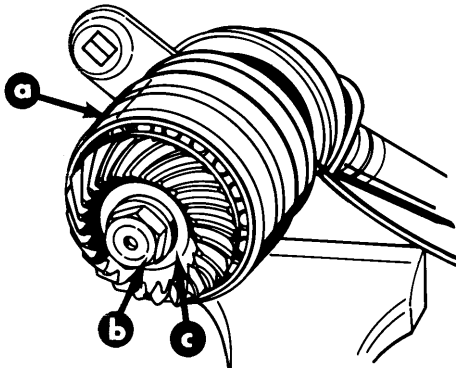
1. Inspect drive gear for pitting, chipped or broken teeth and excessive or uneven wear. If any of these conditions exist, it will be necessary to replace complete drive gear and bearing assembly.
2. Rotate bearings by hand; rough, uneven movement, or a loose condition indicates need for replacement. If drive gear is in good condition, then it will be necessary to replace bearings only.
3. Check splines on coupling end yoke for twisting or cracks.
4. If U-joint knocking is suspected, inspect for evidence of bearing caps hitting center socket.
5. Check cross and bearings for roughness and excessive side-to-side play.

NOTE: *Excessive side-to-side play in cross and bearings can cause U-joint knocking. This condition can sometimes be eliminated by installing a C-ring Kit (P/N 53-12067). This kit contains 8 curved C-rings. These C-rings are used as standard equipment on later production units. Curved C-rings CANNOT be used with replacement cross and bearing assembly P/N 41431.*



Disassembly

1. Remove locknut and washer from U-joint shaft and remove drive gear and bearings.

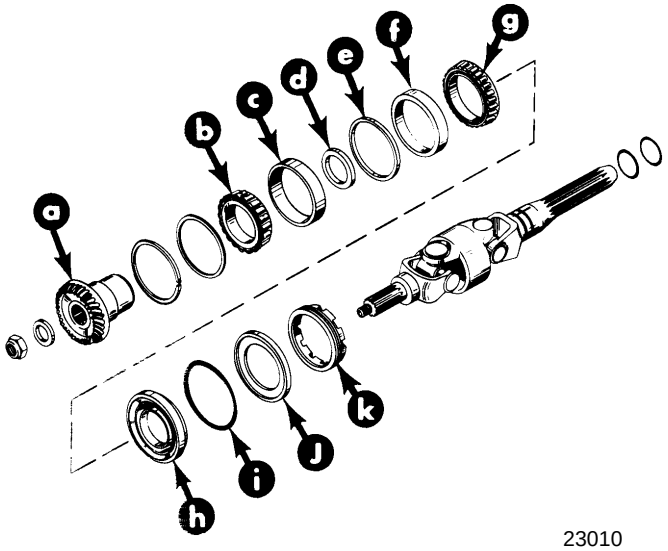


23267

a - Drive Gear And Bearing Assembly
b - Locknut
c - Flat Washer

⚠CAUTION

When disassembling drive gear and bearing assembly, be careful not to switch tapered roller bearings and cups. Bearings must be matched with its original bearing cup. Be sure to note order of components for reassembly. If bearings are to be replaced, replace both bearings and small and large spacers as an assembly, to ensure correct amount of preload when reassembling.



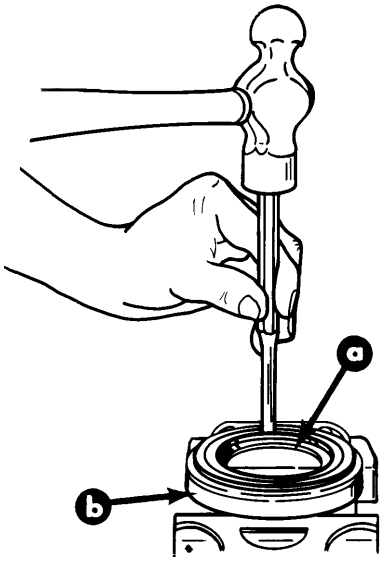
23010

a - Drive Gear
b - Tapered Roller Bearing
c - Bearing Cup
d - Small Spacer (Note 1)
e - Large Spacer
f - Bearing Cup
g - Tapered Roller Bearing
h - Oil Seal Carrier
i - O-ring
j - Roller Bearing Retainer Ring
k - Retainer

NOTE 1-This item will not be included in Later Model units or when ordering the following gear sets:

43-18411A2
43-45814A5
43-55778A3
43-75325A3

2. If seal is defective, remove U-joint seal from carrier using a punch and hammer.



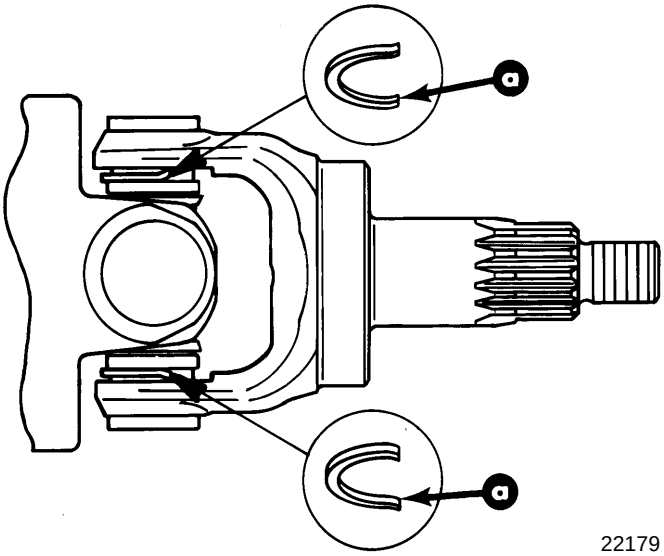
23009

a - Oil Seal
b - Oil Seal Carrier

IMPORTANT: If cross and bearings are to be reused, liberally lubricate crosses with 2-4-C Marine Lubricant to help retain needle bearings in cap during disassembly.

If inspection determines that U-joint cross and bearings should be replaced proceed as follows:

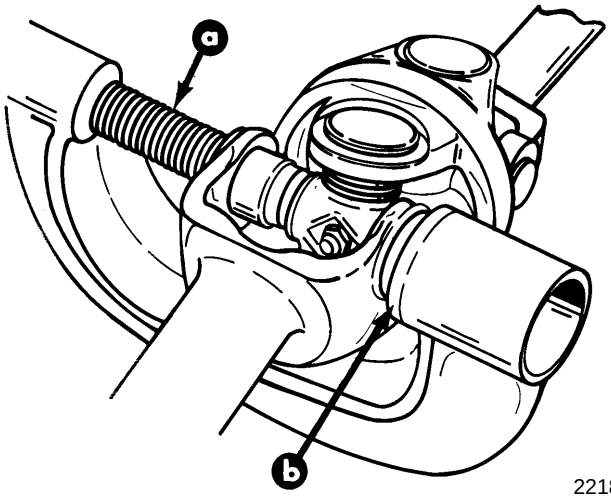
3. Drive off C-rings with punch and hammer.



22179

a - C-ring

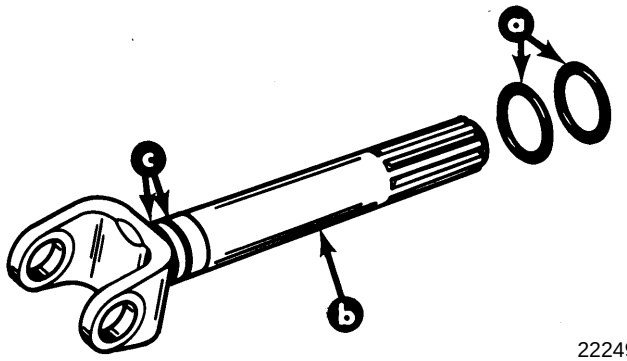
4. Using Adaptor (P/N 91-38756) and U-joint press, press one bearing in until opposite bearing is pressed out into adaptor. Remove loose bearing.



22180

a - U-joint Press
b - Adaptor

5. Turn U-joint assembly 180 degrees and press on cross until second bearing is pressed out into adaptor. Remove each pair of bearings in this manner.
6. Remove both O-rings from coupling end of U-joint shaft. Discard the O-rings.



22249

a - O-rings
b - U-joint Shaft
c - O-ring Grooves

Cleaning

1. Clean all parts (except O-rings) with cleaning solvent.
2. Remove all foreign debris.

⚠CAUTION

DO NOT spin bearings when drying parts with air as damage to bearings could occur.

3. Dry all parts with air or a lint free cloth. Ensure all cleaning solvent has been removed.

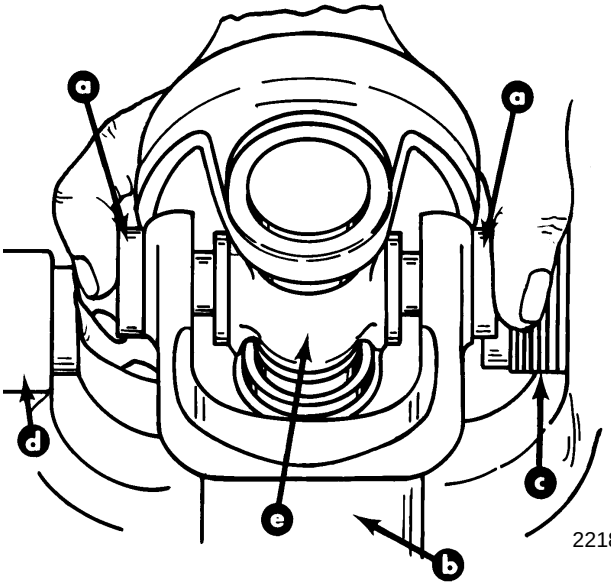
Reassembly

⚠CAUTION

Use only 2-4-C Marine Lubricant for lubricating U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

NOTE: *When initially positioning crosses in yoke, be sure that grease fittings are facing toward coupler yoke (longer yoke).*

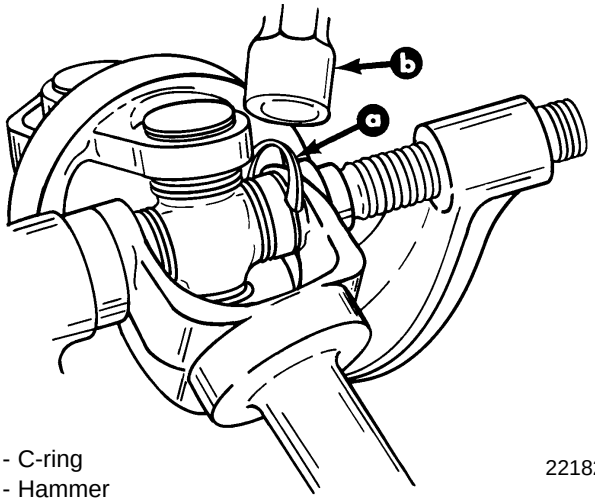
1. Place U-joint bearing cups in yoke and start them onto cross members. Install by using Adaptor (P/N 91-38756) and U-joint Press and pressing both bearings through yoke and onto cross.



22181

a - Bearings
b - Yoke
c - Adaptor
d - U-joint Press
e - Cross

2. Install C-rings into edge of bearing cap.

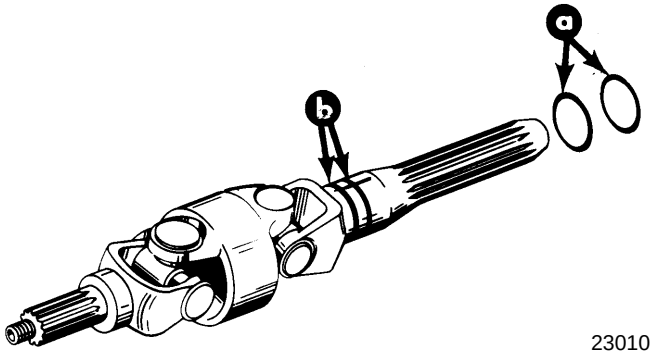


a - C-ring
b - Hammer

22182

3. Install each pair of bearings in this manner.

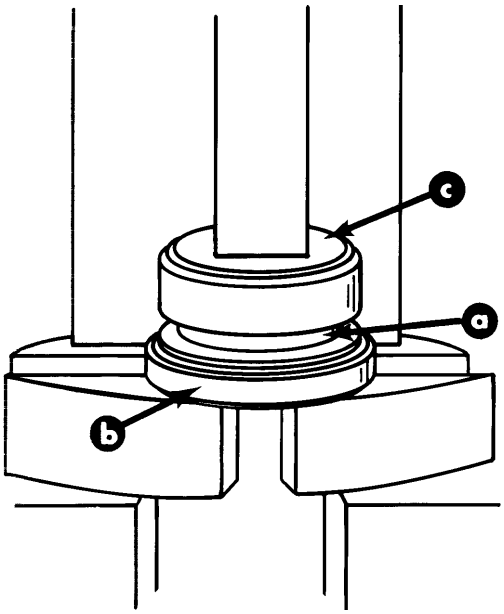
4. Install new O-rings in grooves on coupling end of U-joint shaft.



23010

a - O-rings
b - O-ring Grooves

5. Press oil seal into oil seal carrier with lip of seal facing away from stepped side of carrier. Use oil seal driver (P/N 91-36577) to press seal into place.



23009

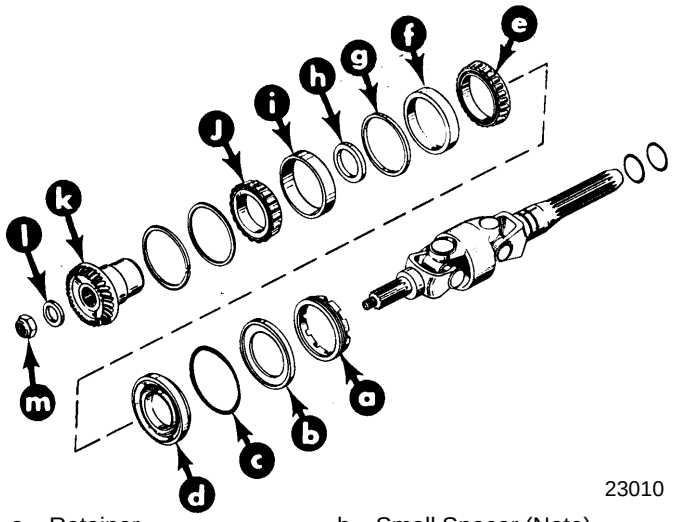
a - Oil Seal
b - Oil Seal Carrier
c - Oil Seal Driver

⚠CAUTION

When reassembling drive gear and bearing assembly, be careful not to switch tapered roller bearing cups. Each bearing must be matched with its original bearing cup. If using old bearings, be sure to use original small and large spacers. If new bearings are being used, be sure to use new spacers. This will ensure proper bearing preload.

Index

6. Install components in order shown.



23010

a - Retainer
b - Anti-galling Retainer
c - O-ring
d - Seal Carrier
e - Tapered Roller Bearing
f - Bearing Cup
g - Large Spacer
h - Small Spacer (Note)
i - Bearing Cup
j - Tapered Roller Bearing
k - Drive Gear
l - Washer
m - Locknut

NOTE: *This item will not be included in Later Model units or when ordering the following gear sets;*

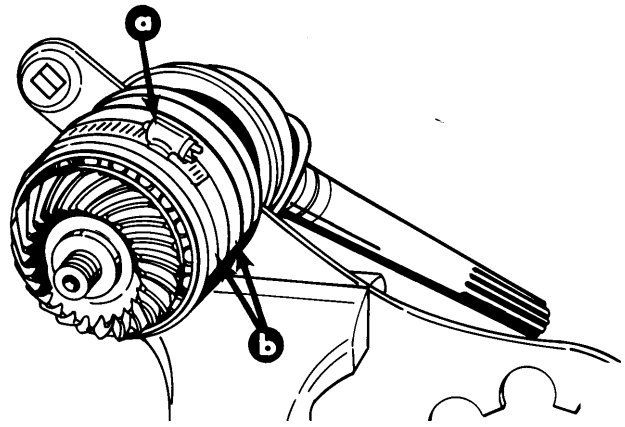
43-18411A2
43-45814A5
43-55778A3
43-75325A3

U-JOINT ASSEMBLY-SETTING PINION BEARING PRELOAD

NOTE: *If not already done, lightly lubricate the gears and bearings with Quicksilver High Performance Gear Lube (P/N 816026A1) before checking preload. Bearings and gears must be lubricated to obtain accurate preload readings.*

Reassembly <u>with</u> Small Spacer:

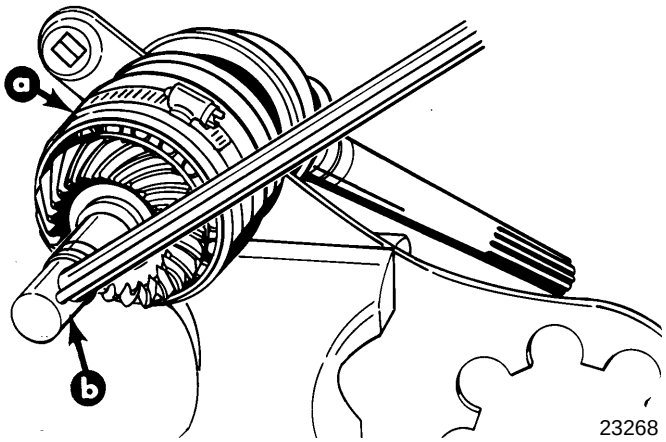
1. Install a hose clamp around large spacer (between Bearing Cups).



23267

a - Clamp
b - Bearing Cups

2. While rotating bearing assembly, torque locknut to 70-80 lb. ft. (95-108 N·m).

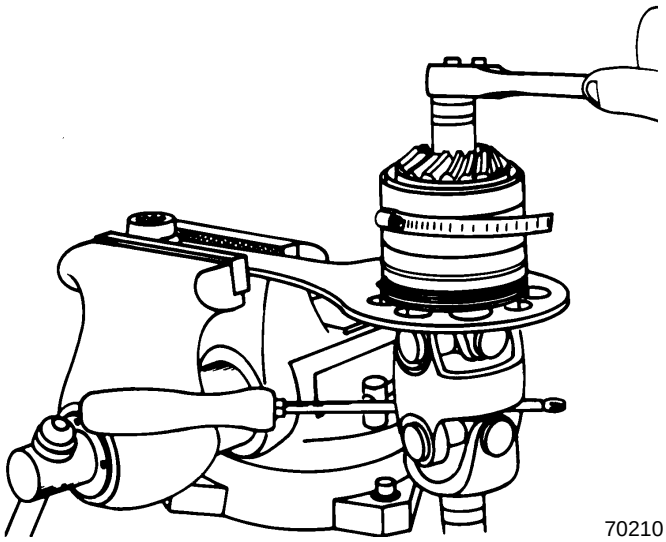


23268

a - Bearing Assembly
b - Torque Wrench

Reassembly <u>without</u> Small Spacer:

1. Insert a suitable tool, such as a screwdriver, between the U-joint yokes as shown in the next figure, to prevent the U-joint from rotating when tightening down the pinion nut. Tighten the pinion nut down until the preload on the bearings starts to go up just slightly and remove the hose clamp.

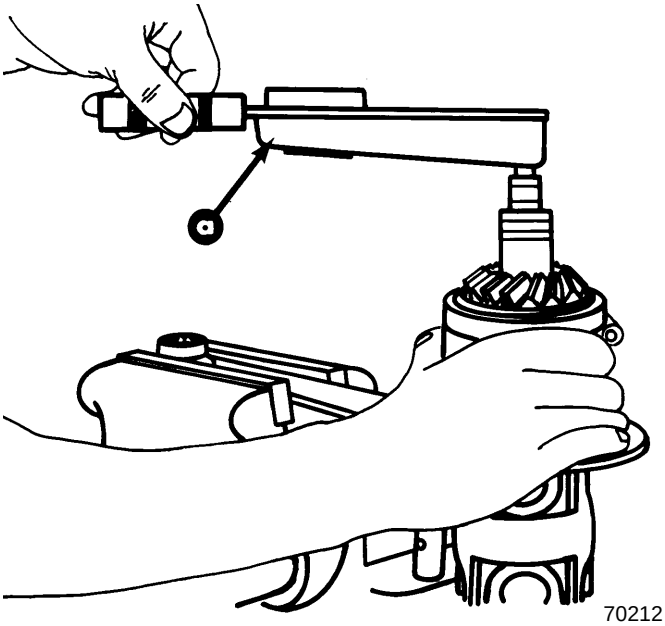


70210

a - U-joint Assembly
b - Vice
c - U-joint Retainer Tool (P/N 91-17256)
d - Screwdriver
e - Socket And Ratchet Wrench

Index

2. While holding the bearings, rotate the pinion nut at least two full revolutions. Check preload by rotating the pinion nut very slowly a third time and, while rotating, take a reading of the preload. If the preload is under the specification of 6-10 lb. in. (0.7-1.1 N·m), torque the pinion nut slightly more (as instructed in the previous step) and recheck preload as outlined above. Continue this sequence until the proper preload is achieved.



70212

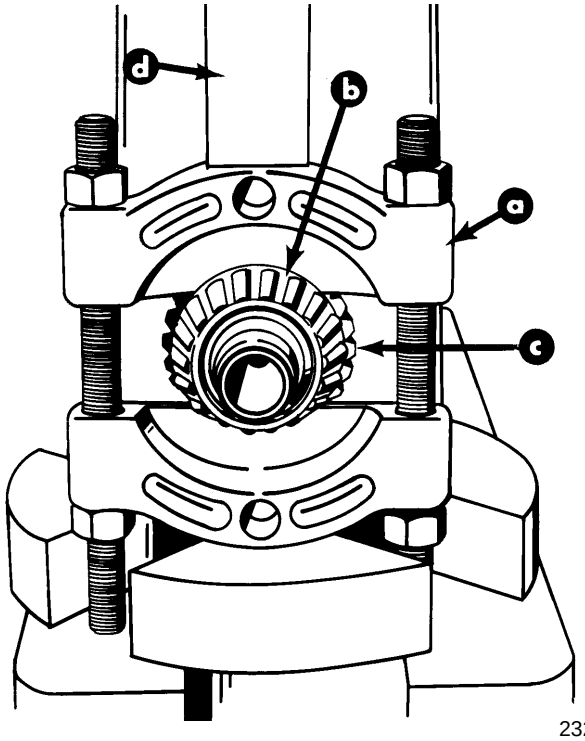
a - Torque Wrench (lb. in.)

IMPORTANT: If while accomplishing the preceding procedure the preload goes over the specified limit of 6-10 lb. in. (0.7-1.1 N·m), the bearings must be totally separated from the gear and reassembled following the appropriate previous instructions starting with "U-Joint Assembly," 'Inspection and Disassembly' section found on page 3A-8. Failure to follow these instructions will cause premature failure of the unit.

Upper Drive Shaft and Driven Gear Assembly Servicing

Disassembly

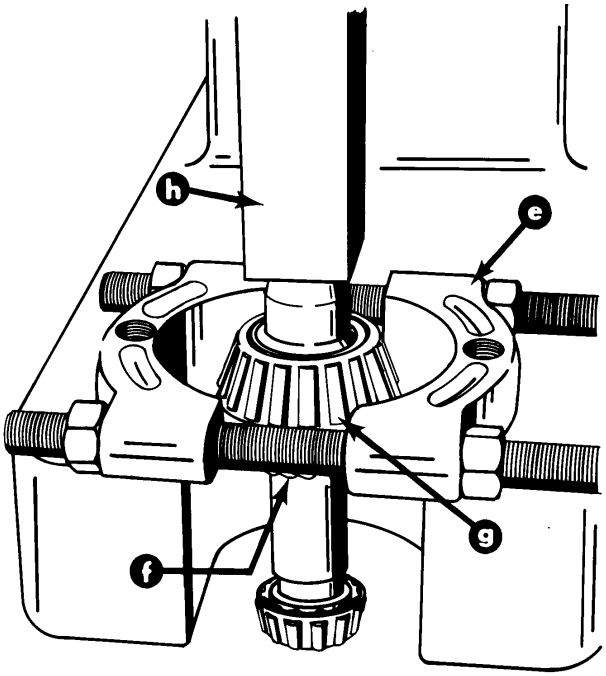
1. Position Universal Puller Plate (P/N 91-37241) between driven gear and tapered roller bearing.
2. Press on plate until it bottoms.



23265

a - Universal Puller Plate
b - Tapered Roller Bearing
c - Driven Gear
d - Arbor Press

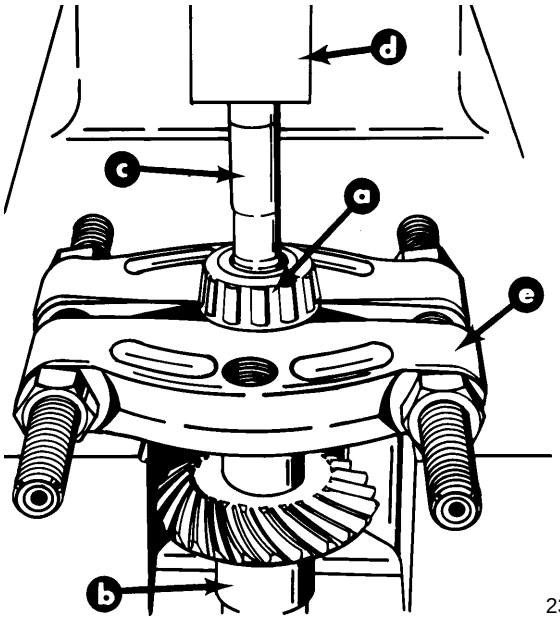
3. Press on driven gear end until tapered roller bearing slides off.



23264

e - Universal Puller Plate
f - Driven Gear
g - Tapered Roller Bearing
h - Arbor Press

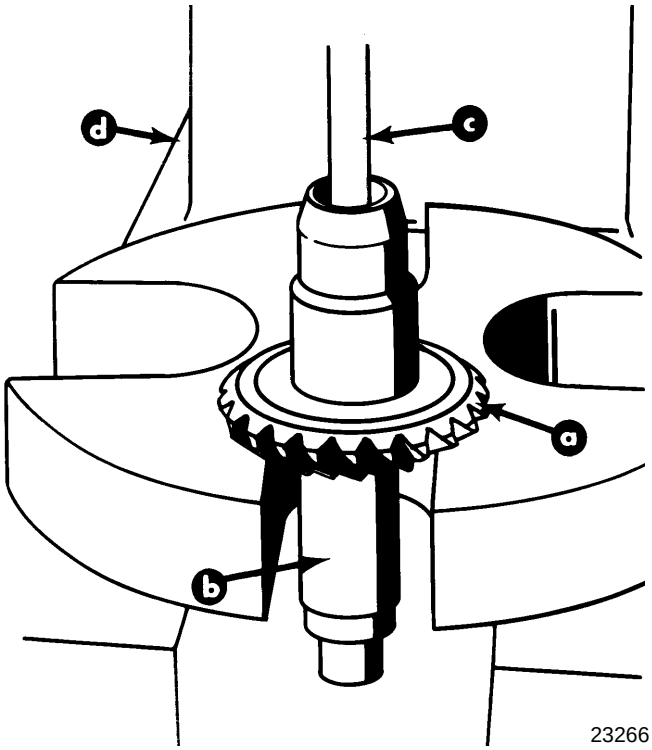
4. Remove (smaller) upper drive shaft tapered roller bearing.



23265

a - Upper Drive Shaft Bearing (Smaller)
b - Upper Drive Shaft
c - Suitable Tool
d - Arbor Press
e - Universal Puller Plate (P/N 91-37241)-Flat Side Of Plate Toward Bearing

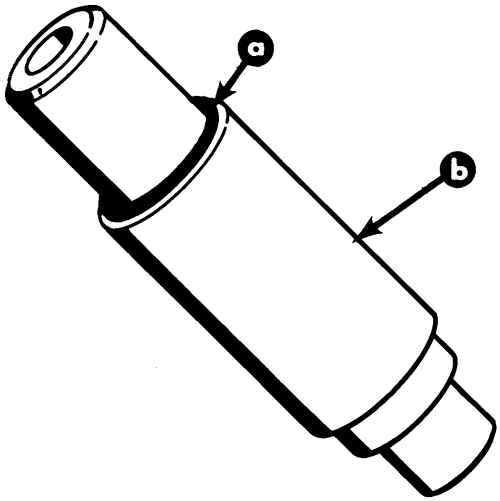
5. Press driven gear from upper drive shaft.



23266

a - Driven Gear
b - Upper Drive Shaft
c - Suitable Tool
d - Arbor Press

6. Remove upper drive shaft O-ring (on gear side of shaft only). Discard the O-ring.



50313

a - O-ring
b - Upper Drive Shaft

Index

Cleaning

1. Clean all parts (except O-ring) with cleaning solvent.
2. Remove all foreign debris.

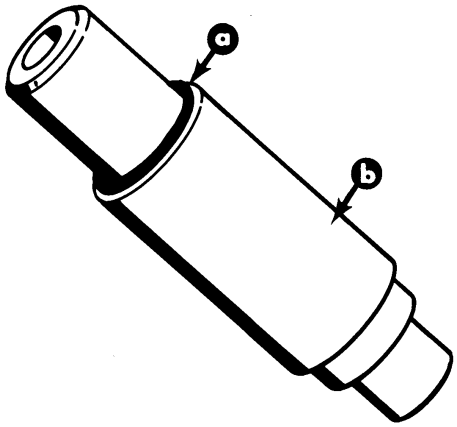
⚠CAUTION

DO NOT spin bearings when drying components off with compressed air, as damage to bearings could occur.

3. Dry all parts with compressed air or a lint free cloth. Ensure all solvent has been removed.

Reassembly

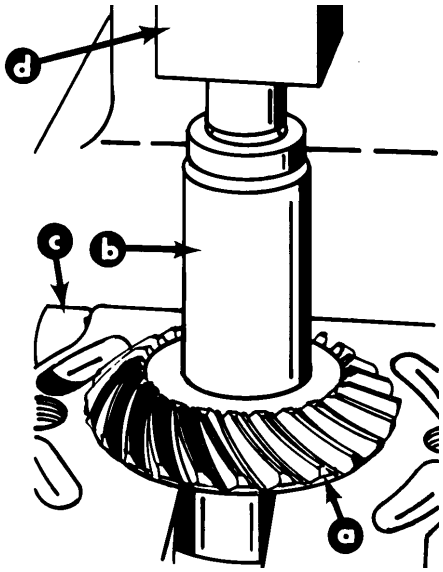
1. Place new O-ring on the upper drive shaft.



50313

a - O-ring
b - Upper Drive Shaft

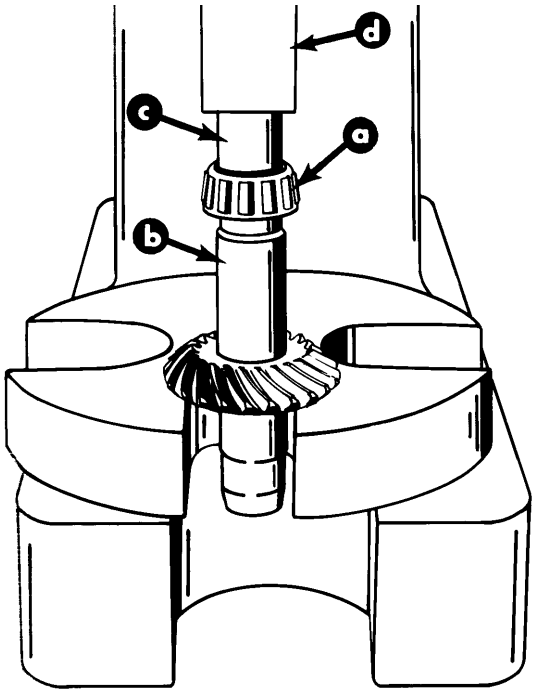
2. Press upper drive shaft onto driven gear until it bottoms.



23264

a - Driven Gear
b - Upper Drive Shaft
c - Universal Puller Plate
d - Arbor Press

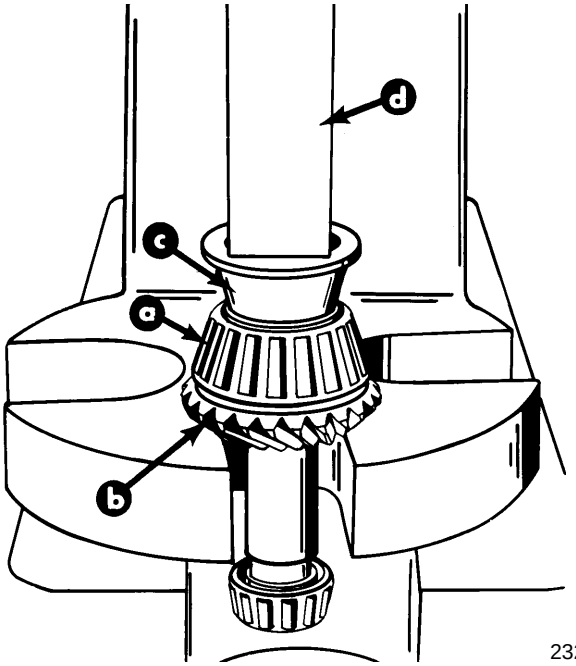
3. Press upper drive shaft (smaller) bearing onto upper drive shaft until it bottoms.



23264

a - Upper Drive Shaft Bearing (Smaller)
b - Upper Drive Shaft
c - Suitable Tool
d - Arbor Press

4. Press tapered roller bearing onto driven gear until it bottoms.



23263

a - Tapered Roller Bearing (Larger)
b - Driven Gear
c - Suitable Tool
d - Arbor Press

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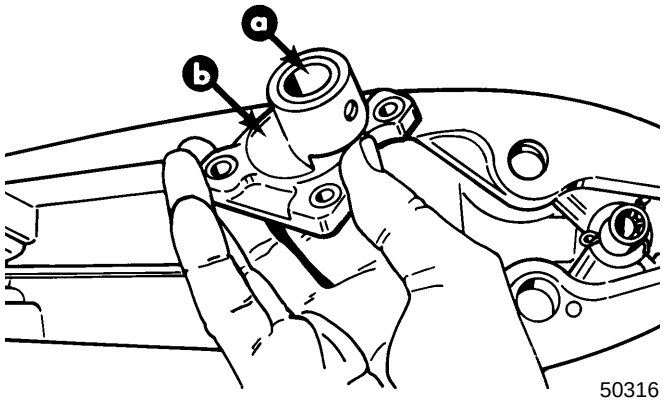
Water Pocket Cover Servicing

Disassembly

1. Remove rubber seal from water pocket cover.



50316

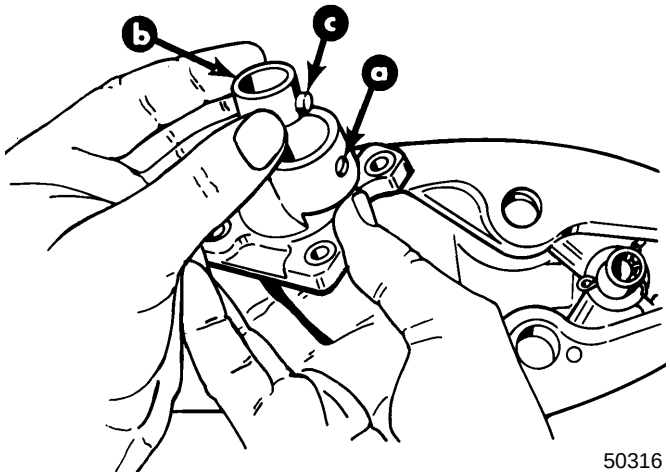
a - Rubber Seal
b - Water Pocket Cover

Cleaning and Inspection

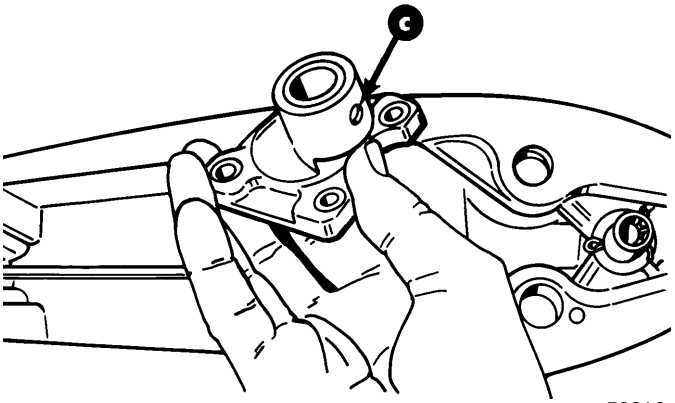
1. Clean water pocket cover and rubber seal with a water and soap solution.
2. Dry parts completely with compressed air or a lint free cloth.
3. Inspect parts for signs of overheating (melting, warping or cracks).

Reassembly

1. Install rubber seal into water pocket cover. Ensure that embossment on seal fits into hole in water pocket cover.



50316



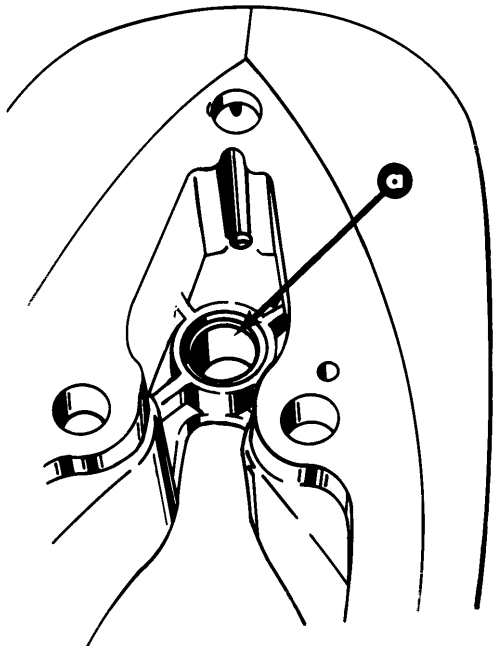
50316

a - Water Pocket Cover Hole
b - Rubber Seal
c - Embossment

Drive Shaft Housing Reassembly and Shimming

IMPORTANT: The shifter shaft bushing for the Alpha One SS is made of plastic. Use care when installing this bushing to avoid cracking it.

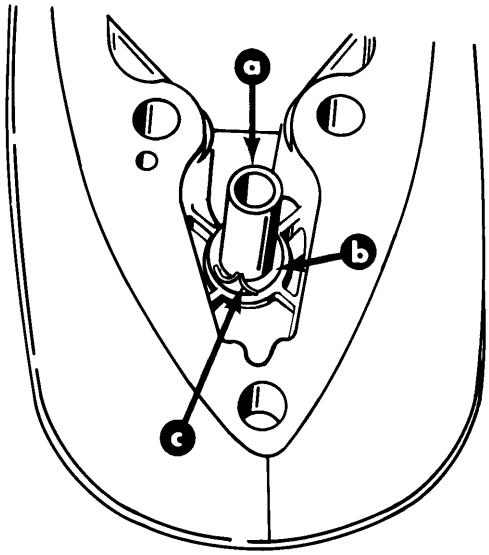
1. Install shifter shaft bushing using a suitable tool.



23261

a - Bushing (Not Used On Later Models)

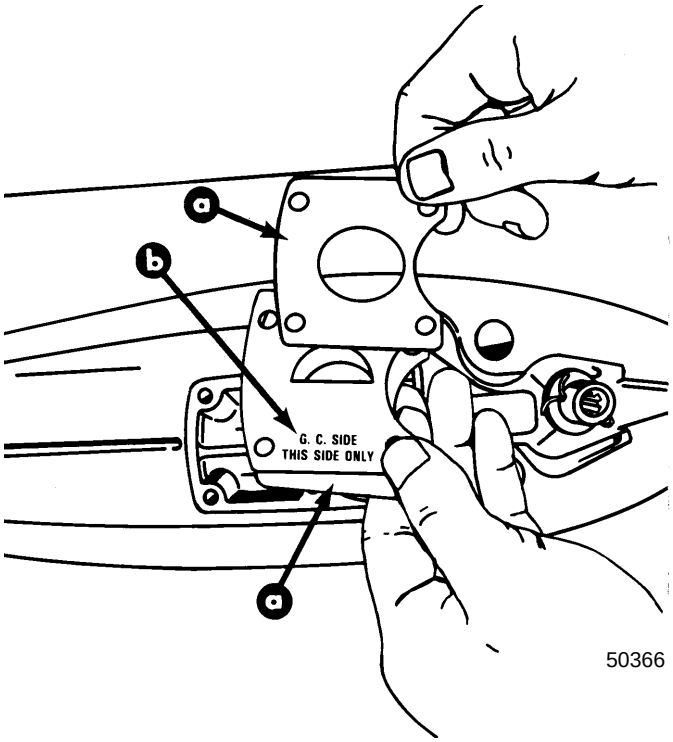
2. Install intermediate shift shaft.



23261

a - Intermediate Shift Shaft
b - Flat Washer
c - Cotter Pin-Spread Both Ends

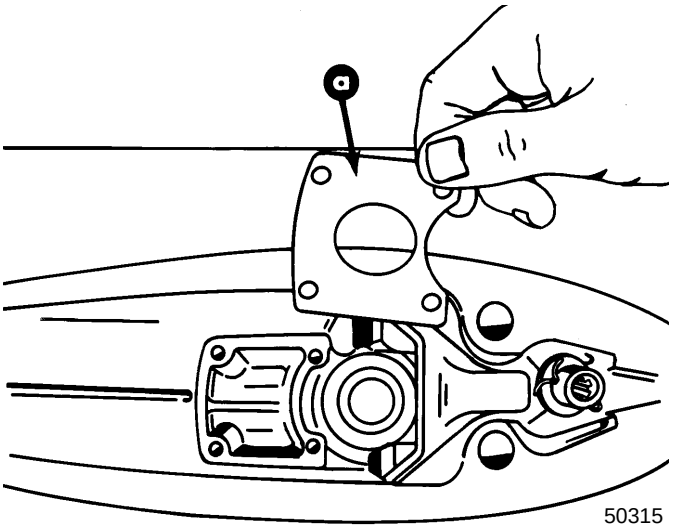
IMPORTANT: The Alpha One SS drive shaft housing has a restrictor plate sandwiched between two gaskets located beneath the water pocket cover (the Alpha One and MR units have only a gasket). This restrictor plate must be installed with the side marked "G.C. SIDE-THIS SIDE ONLY" facing toward gear case.



50366

Alpha One SS

a - Gaskets
b - Restrictor Plate



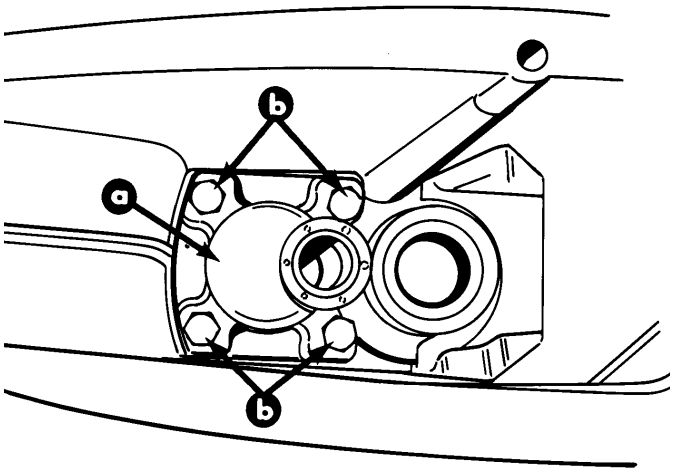
50315

Alpha One and MR

a - Gasket

Index

3. Install water pocket cover and gasket(s). Apply Perfect Seal to screw threads and torque to 30-40 lb. in. (3-4 N·m).



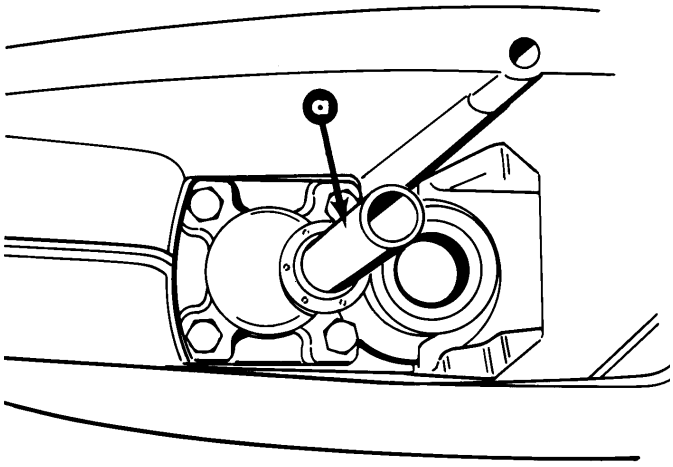
50316

a - Water Pocket Cover [Gasket(s) Beneath]
b - Screws (4)

⚠CAUTION

Alpha One SS has a shorter water tube than the Alpha One or MR drive units. Be careful not to install a short tube (Alpha One SS) in an Alpha One or MR drive unit, as this would substantially reduce water flow to the engine, causing engine to overheat.

4. Install water tube (copper) into water pocket cover.



50316

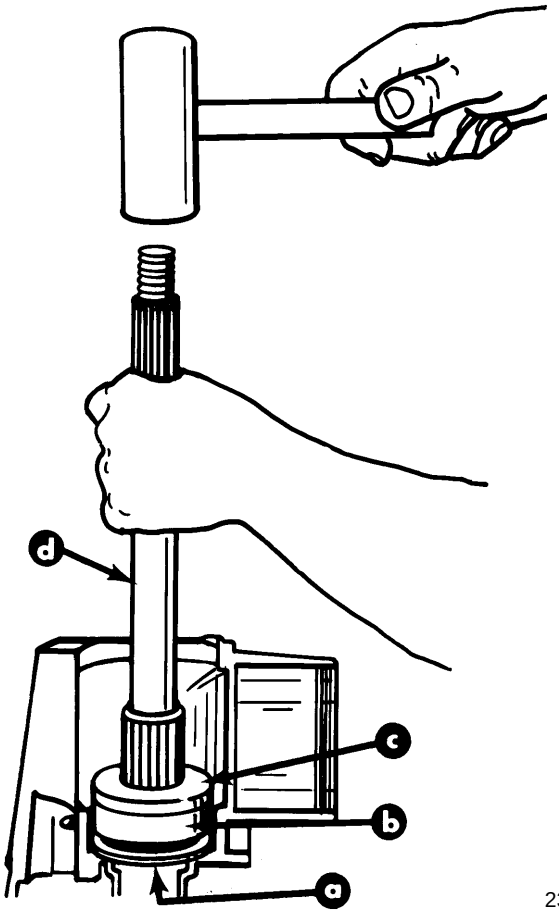
a - Water Tube

IMPORTANT: Lubricate gears, bearings, seals and O-rings with Quicksilver High Performance Gear Lube before installing. Bearings and gears must be lubricated to obtain accurate preload readings, following.

5. Place shims in drive shaft housing.

NOTE: *If installing the upper driven gear bearing cup for the first time use the same thickness of shims that were removed or a .015 in. (0.38 mm) shim pack if the original shim pack thickness is not known.*

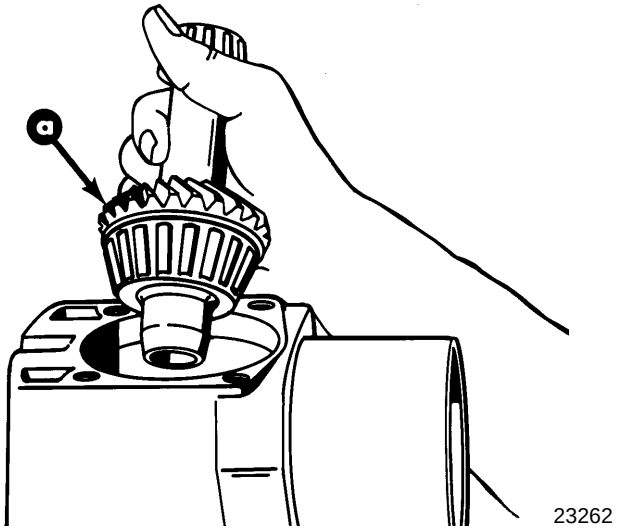
6. Install driven gear tapered roller bearing cup.



23011

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (P/N 91-33493)
d - Driver Rod (Old Propeller Shaft Shown)

7. Install upper drive shaft and driven gear assembly.

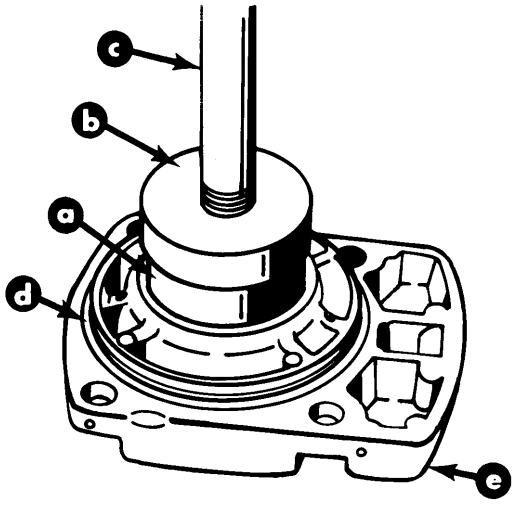


a - Upper Drive Shaft And Driver Gear Assembly

8. Place shims in top cover.

NOTE: *If using new shims, start with .015-.020 in. shim pack.*

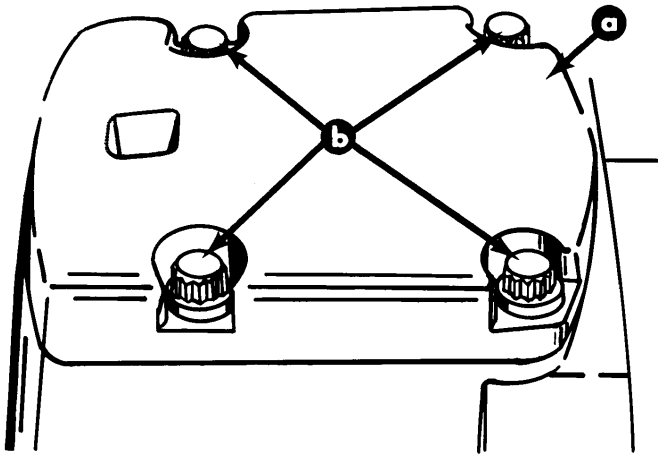
9. Install upper drive shaft bearing cup into top cover. Install O-ring.



a - Bearing Cup (Shims Underneath)
b - Bearing Cup Driver (P/N 91-38918)
c - Driver Rod (P/N 91-37323)
d - O-ring
e - Top Cover

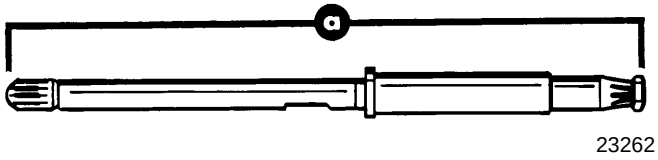
IMPORTANT: Top cover must be torqued to specifications to ensure proper upper drive shaft bearing preload.

10. Install top cover. Torque screws to 20 lb. ft. (27 N·m).



a - Top Cover
b - Screws (4)

11. Check upper drive shaft bearing preload and shim as follows:
    a. Invert upper drive shaft housing.
    b. Insert gear housing drive shaft (with pinion gear nut installed) into upper drive shaft splines.



a - Gear Housing Drive Shaft

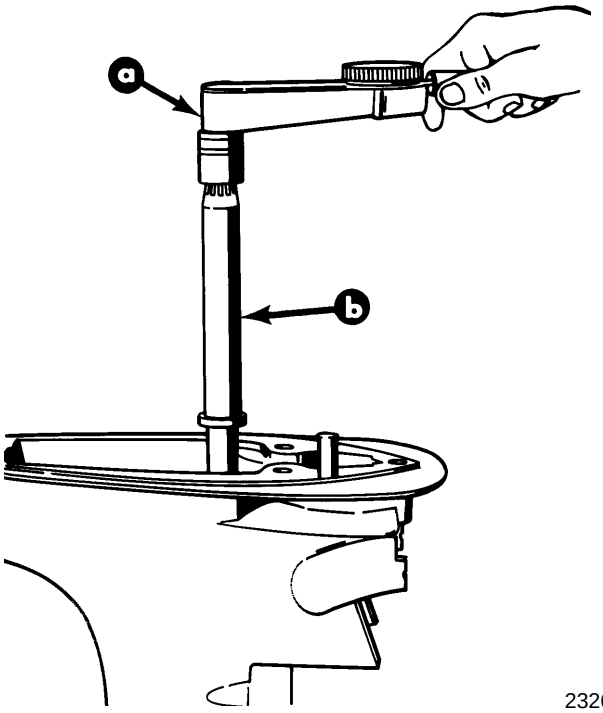
c. Make sure bearings and gear have been lubricated. Turn drive shaft clockwise several times to seat bearings.

d. Using lb. in. torque wrench (P/N 91-66274) on drive shaft; SLOWLY turn drive shaft clockwise and not gauge reading. Reading should be:

USED BEARINGS: 2.5-4 lb. in. (0.3-0.45 N·m).

NEW BEARINGS: 6-10 lb. in. (0.71-1.0 N·m).

NOTE: *Bearings are considered used if spun under load once.*



23262

a - Torque Wrench (lb. in.)
b - Drive Shaft

e. Re-shim as necessary:

If reading is too high; remove shims from beneath bearing cup in top cover.

If reading is too low; add shims beneath bearing cup in top cover.

If reading is within specifications; reinstall top cover and torque screws to 20 lb. ft. (27 N·m).

f. Recheck bearing preload and adjust shim thickness until specified preload is attained.

12. Check upper drive shaft driven gear height and shim as follows:

IMPORTANT: Upper drive shaft bearing preload must be correct and top cover must be properly torqued before checking driven gear height.

a. Using the chart following, select proper opening in shimming tool (P/N 91-60526).

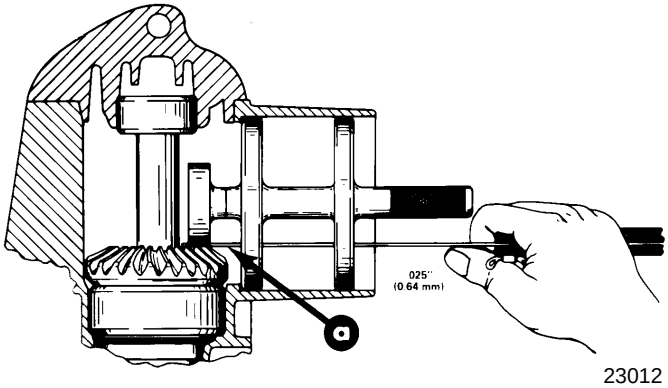
b. Insert shimming tool into drive shaft housing with appropriate opening toward gear.

SHIMMING TOOL 91-60526	
Overall Drive Unit Gear Ratio	**Tool Position**
1.32:1	Z
1.50:1	Z
1.65:1	X
1.84:1	Y
1.98:1	Y

IMPORTANT: The following procedure must be done exactly as stated to position shimming tool gauging surface parallel with gear to obtain an accurate measurement.

c. Position gear so that at least two full teeth are centered on gauging surface. One full tooth must be on each side of gauging surface center-line. Insert a .025 in. (0.64 mm) feeler gauge between one of the teeth and gauging surface.

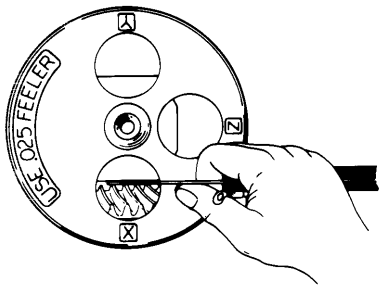
Rotate shimming tool until gauging surface contacts feeler gauge and a slight drag on feeler gauge is felt.



23012

a - .025 in. (0.64 mm) Feeler Gauge

d. Without moving shimming tool, remove feeler gauge and insert gauge between other tooth and gauging surface.



23012

Index

If feeler gauge can be inserted with only a slight drag, shimming is correct. Proceed in reassembly with step 13.

If feeler gauge inserts with no drag, gear is too low. Repeat steps 12-c and 12-d with progressively thicker feeler gauges until the same clearance is obtained between both gear teeth and gauging surface. Calculate the thickness of shims to add under driven gear bearing cup as shown following.

Clearance Between Gear-Tooth and Shimming Tool	.025 in. = Additional Thickness Shims Required

Example: .028 in.-.025 in. = .003 in.
(0.71 mm-0.64 mm) = (.076 mm)

Shims equal to the resulting difference must be added beneath driven gear bearing cup.

IMPORTANT: Be sure to remove shims from beneath top cover bearing cup in proportion to those added under driven gear bearing cup, in order to maintain proper preload.

If feeler gauge cannot be inserted without moving shimming tool, gear is too high. Repeat steps 12-c and 12-d with progressively thinner feeler gauges until the same clearance is obtained between both gear teeth and gauging surface. Calculate the thickness of shims to be removed from under driven gear bearing cup as follows:

.025 in. (0.64 mm)	– Clearance Between Gear Teeth and Shimming Tool	=	Reduction in Shim Thickness Required

Example: .025 in.-.021 in. = .004 in.
(0.64 mm-.522 mm) = (.10 mm)

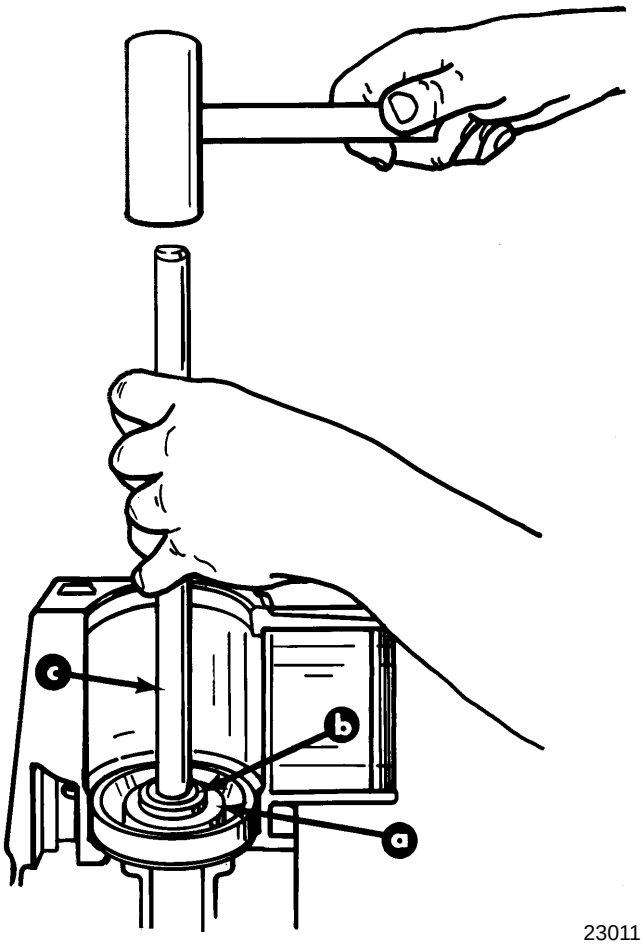
Shims equal to the resulting difference must be removed from beneath driven gear bearing cup.

IMPORTANT: Be sure to add shims beneath top cover bearing cup in proportion to those removed from under driven gear bearing cup, in order to maintain proper preload.

e. Recheck bearing preload and proceed with reassembly, Step 13.

13. Remove top cover and upper drive shaft and driven gear assembly.

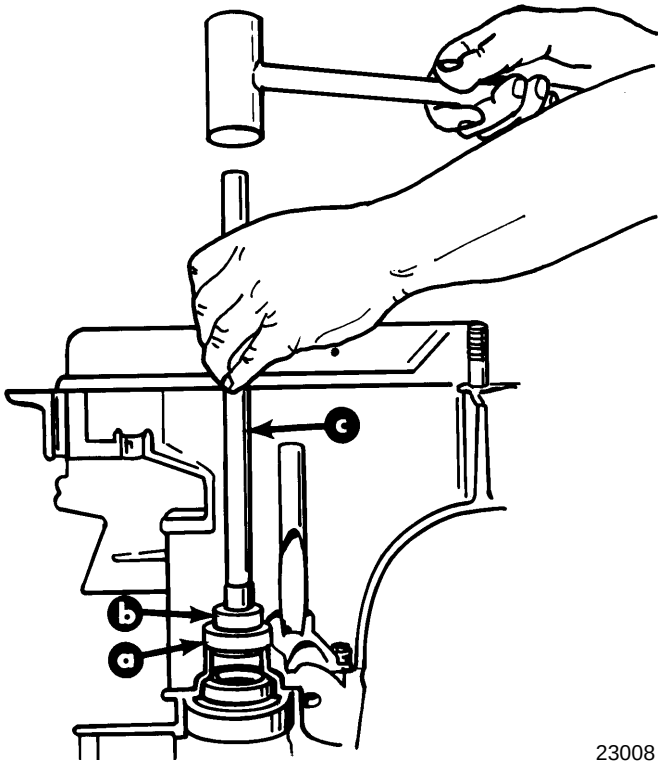
14. Apply Loctite 27131 or Type "A" to outside diameter of drive shaft housing upper oil seal and install oil seal with lips facing up.



23011

a - Upper Oil Seal
b - Oil Seal Installation Tool (P/N 91-43591)
c - Driver Rod (P/N 91-37323)

15. Apply Loctite 27131 or Type “A” to outside diameter of drive shaft housing lower oil seal and install oil seal with lips facing up (toward top of housing).



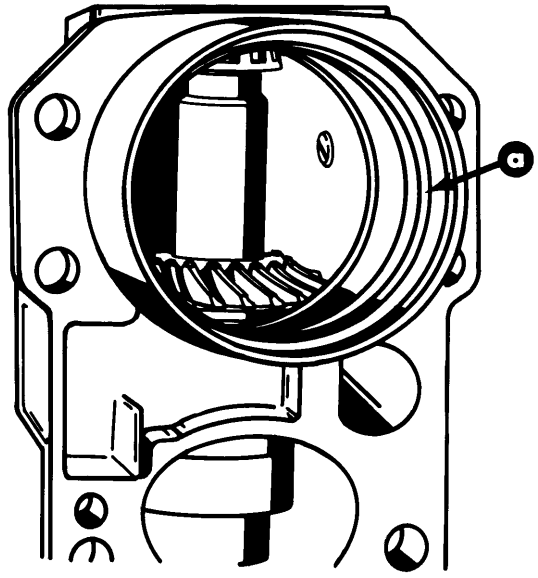
23008

a - Lower Oil Seal
b - Oil Seal Installation Tool (P/N 91-43591)
c - Driver Rod (P/N 91-37323)

16. Reinstall upper drive shaft and driven gear assembly. Do not install top cover at this time.

17. Place drive gear shims in drive shaft housing.

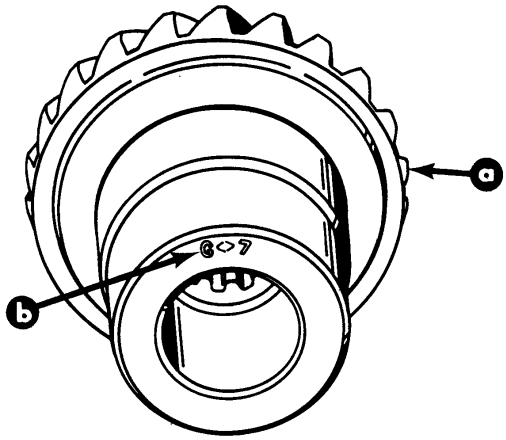
NOTE: *If using new shims, start with a .025 in. (0.65 mm) shim pack.*



23266

a - Shims

IMPORTANT: Before beginning drive gear shimming, make a note of the date code that is stamped on the face of the drive gear if using heavy duty gears. A variation in feeler gauge used for checking drive gear depth is needed for checking gears stamped with date code “G-7”.



50366

Units with 1.65:1 Gear Ratio Only

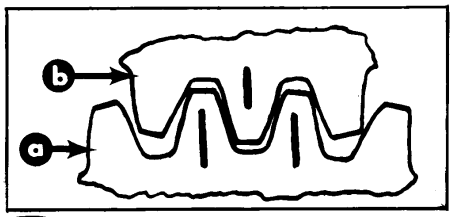
a - Drive Gear
b - Date Code (G-7)

18. Install U-joint assembly into drive shaft housing as follows:

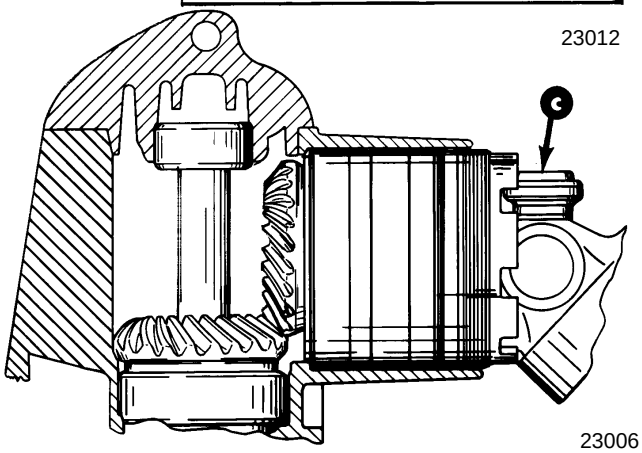
NOTE: *Newer 1.65:1 replacement gears do not have index marks. For these units, refer to the next step on the following page.*

a. Align index marks on drive gear with index mark on driven gear.

b. Push U-joint assembly straight into drive shaft housing so that index marked teeth properly mesh.



23012

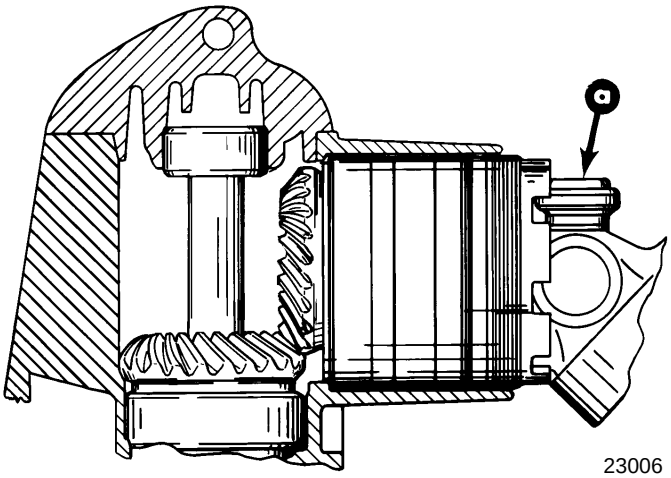


23006

a - Drive Gear Index Marks
b - Driven Gear Index Marks
c - U-joint Assembly

All Units without 1.65:1 Gear Ratio

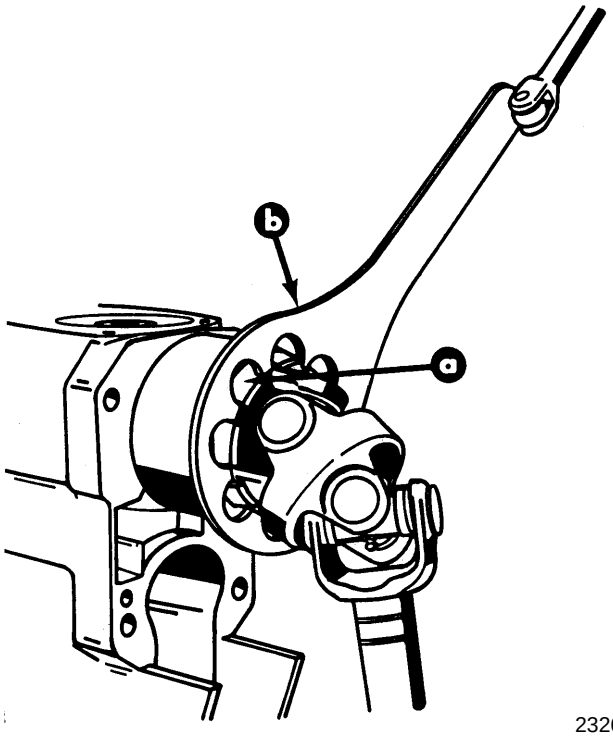
a. Push U-joint assembly straight into drive shaft housing so that gear teeth mesh.



23006

a - U-joint Assembly

19. Tighten bearing retainer. Torque to 200 lb. ft. (271 N·m).

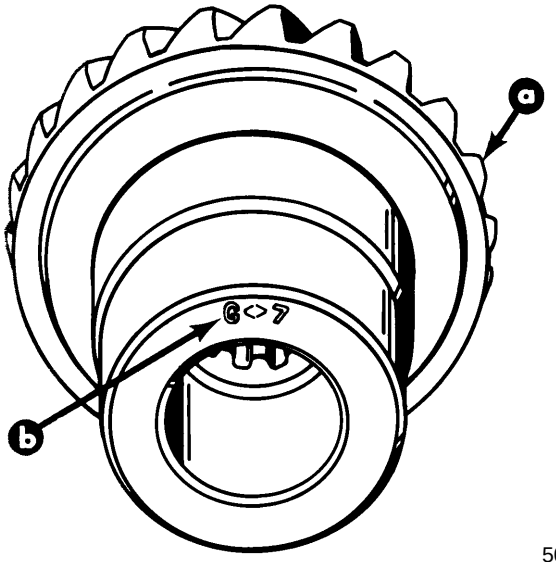


23268

a - Bearing Retainer
b - Bearing Retainer Wrench

IMPORTANT: The following procedure must be performed exactly as stated to position shimming tool gauging surface parallel with gear to obtain an accurate measurement.

IMPORTANT: When using heavy duty gears with date code “G-7” stamped on face of gear, use of a .032 in. feeler gauge should be used instead of .025 in.



50366

a - Drive Gear
b - Date Code “G-7”

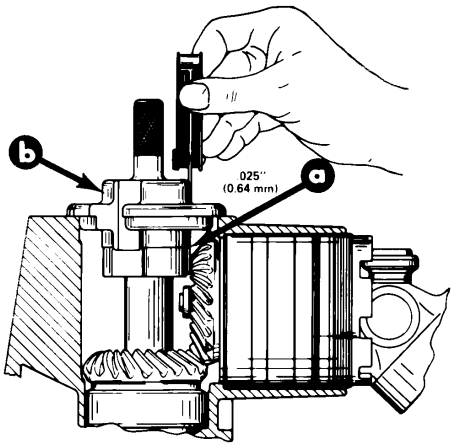
20. Check drive gear (U-joint assembly) depth and shim as follows:

    a. Using chart following, select proper opening in Shimming Tool (P/N 91-60523).

    b. Insert shimming tool into drive shaft housing with appropriate opening toward gear.

SHIMMING TOOL 91-60523	
Overall Drive Unit Gear Ratio	**Tool Position**
1.32:1	Z
1.50:1	Z
1.65:1	Y
1.84:1	Y
1.98:1	Y

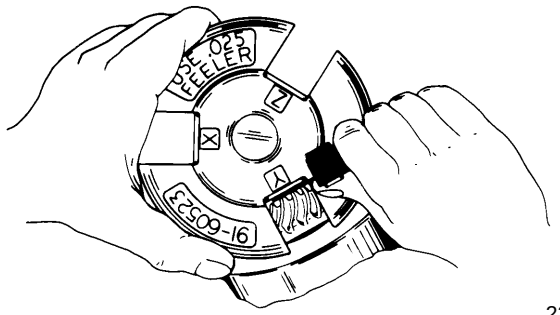
    c. Position gear so that at least two full teeth are centered on gauging surface. One full tooth must be on each side of gauging surface centerline. Insert a .025 in. (0.64 mm) (.032 in. with Heavy Duty Gears Stamped G-7) feeler gauge between one of the teeth and gauging surface. Rotate shimming tool until gauging surface contacts feeler gauge and a slight drag is felt (while holding shimming tool down on housing).



23012

a - Feeler Gauge-(.025 in. or .032 in.)
b - Shimming Tool

    d. Without moving shimming tool, remove feeler gauge and insert gauge between other tooth and gauging surface.



23012

If feeler gauge can be inserted with only a slight drag, shimming is correct. Proceed with reassembly Step 21.

If feeler gauge inserts with no drag, gear is too far away from tool. Repeat Steps 20-c and 20-d with progressively thicker feeler gauges until the same clearance is obtained between both gear teeth and gauging surface. Calculate shim thickness to be removed from between U-joint assembly bearing cup and drive shaft housing shoulder, as shown following.

NOTE: *Be sure to substitute .032 in. for .025 in. if using heavy duty gears with date code "G-7", when making the following calculations.*

Clearance Between-.025 in. = Shimming Thickness
Gear Teeth and (0.64 mm) Change Required
Shimming Tool

Example: .030 in.-.025 in. = .005 in.
(.762 mm-0.64 mm = .127 mm)

Shims equal to the resulting difference must be removed from between U-joint assembly bearing cup and drive shaft housing shoulder.

If feeler gauge cannot be inserted without moving shimming tool, gear is too close to tool. Repeat Steps 20-c and 20-d with progressively thinner feeler gauges until some clearance is obtained between both gear teeth and gauging surface. Calculate shim thickness to be added between U-joint assembly bearing cup and drive shaft housing shoulder, as shown following.

NOTE: *Be sure to substitute .032 in. for .025 in., if using heavy duty gears with date code "G-7", when making the following calculations.*

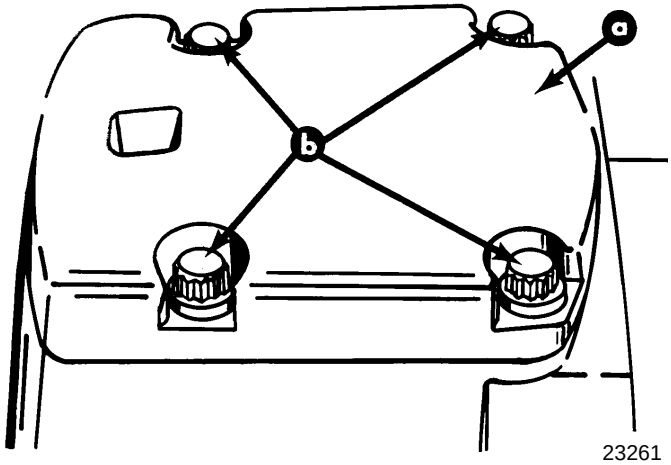
.025 in.-Clearance Between = Shimming Thickness
(0.64 mm) Gear Teeth and Change Required
Shimming Tool

Example: .025 in.-.023 in. = .002 in.
(0.64 mm-.584 mm = .056 mm)

Shims equal to the resulting difference must be added between U-joint assembly bearing cup and drive shaft housing shoulder.

Index

21. Ensure U-joint retainer nut is torqued to 200 lb. ft. (217 N·m).
22. Install top cover and torque screws to 20 lb. ft. (27 N·m).



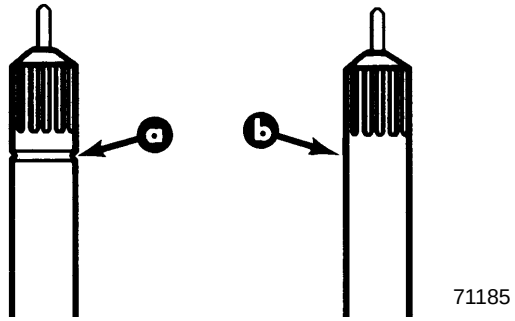
23261

a - Top Cover
b - Screws

Gear Housing Installation

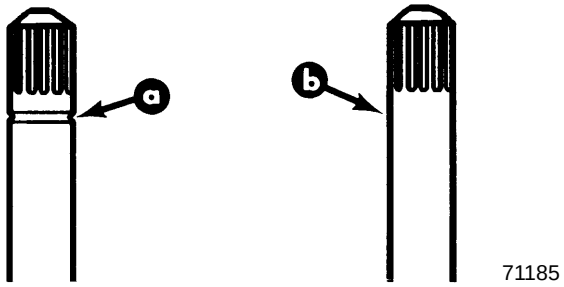
ALPHA I AND MC I DRIVE SHAFT CHANGES

The service drive shaft for the lower unit will no longer have an O-ring groove at the top of the shaft under the splines on all Alpha One 1990 and prior and also MC through 1976. All present production units contain the New Style shaft without an O-ring groove also.



71185

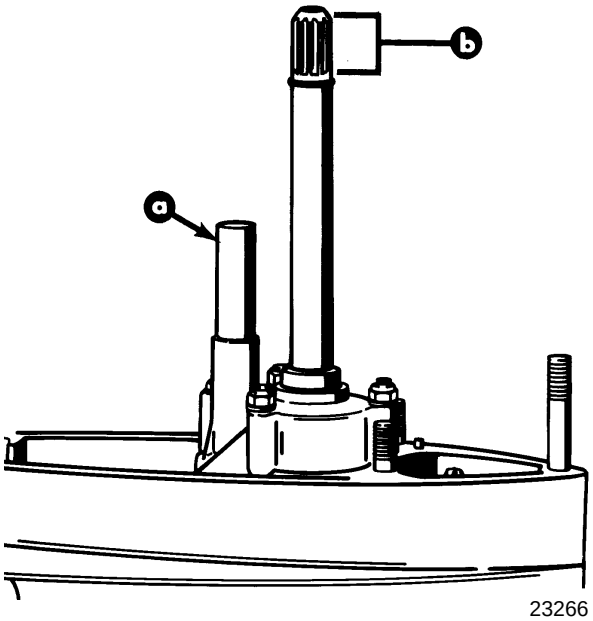
a - MC I Old Style (With O-ring Groove)
b - MC I New Style (Without O-ring Groove)



71185

a - Alpha One Old Style (With O-ring Groove)
b - Alpha One New Style (Without O-ring Groove)

1. Lubricate end of water tube and drive shaft splines with 2-4-C Marine Lubricant.

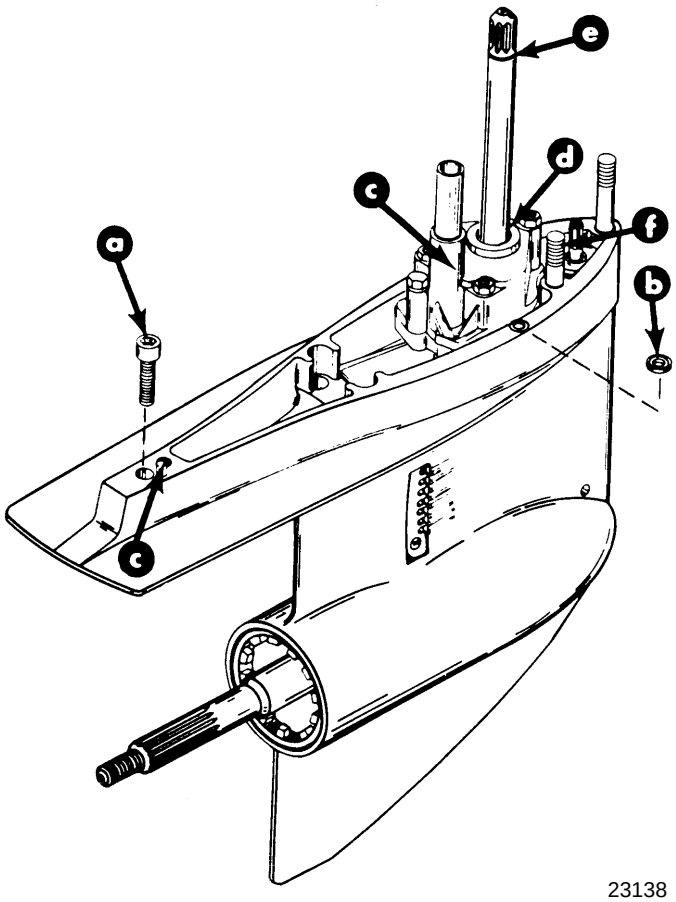


23266

a - Water Tube
b - Drive Shaft Splines-Lubricate

2. Install trim tab allen screw.
3. Install oil seal and apply Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal to oil seal.
4. Check that alignment pins, centrifugal slinger and drive shaft O-ring is in place.
5. Move gear housing shift shaft clockwise to shift gear housing into forward gear.

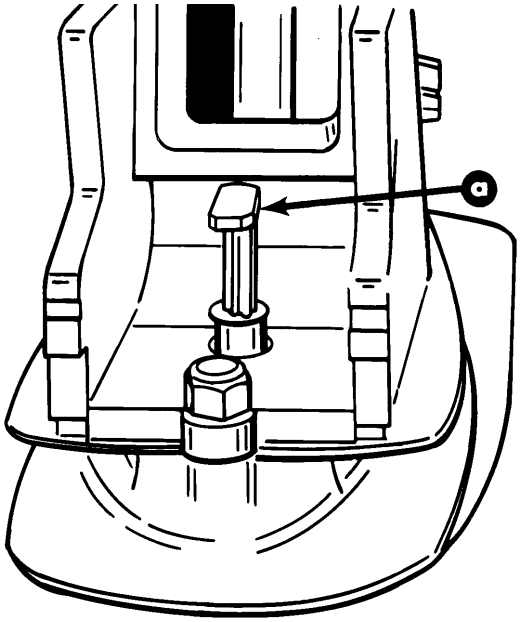
NOTE: *Gear housing may be held in forward gear by applying light pressure to propeller shaft in counterclockwise direction.*



23138

a - Trim Tab Allen Screw
b - Oil Seal
c - Alignment Pins
d - Centrifugal Slinger
e - O-ring (If Present)
f - Shift Shaft

6. Place drive shaft housing shift shaft in the full forward position.



23265

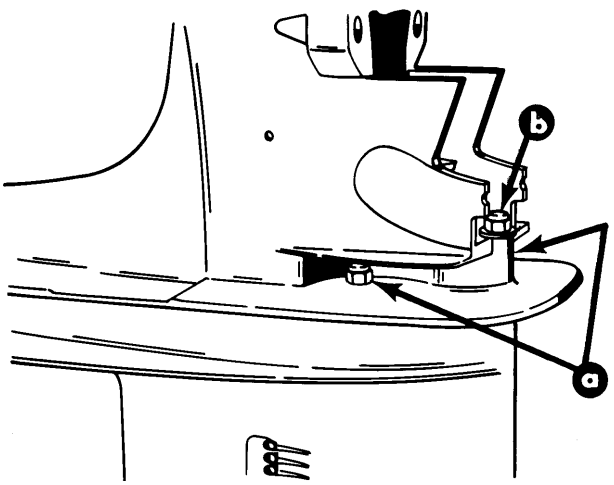
a - Shift Shaft

NOTE: *If propeller shaft is rotated in a clockwise direction before shift shafts are coupled, gear housing must be shifted back into forward gear and held in position.*

7. Align water tube with tube guide and drive shaft and shift shaft splines with upper drive shaft and shift shaft splines and install gear housing.

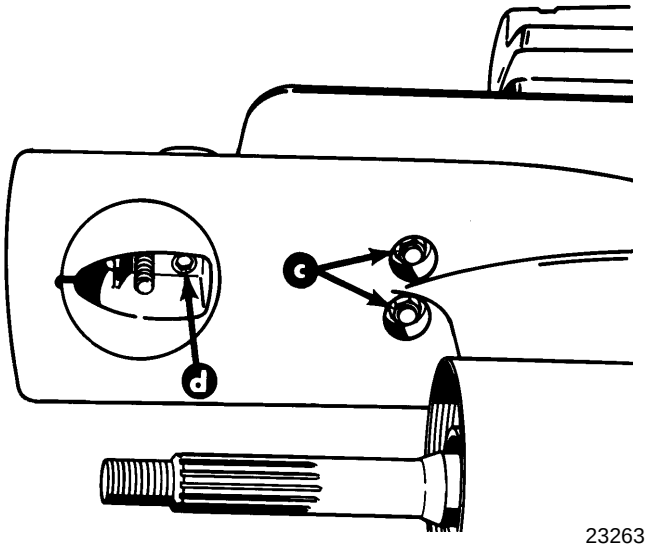
NOTE: *Rotate propeller shaft counterclockwise only after shift shaft splines have engaged. This will help engage drive shaft splines.*

8. Secure gear housing to drive shaft housing as shown. Torque locknuts to 35 lb. ft. (47 N·m). Torque allen screw to 38 lb. ft. (38 N·m).



23261

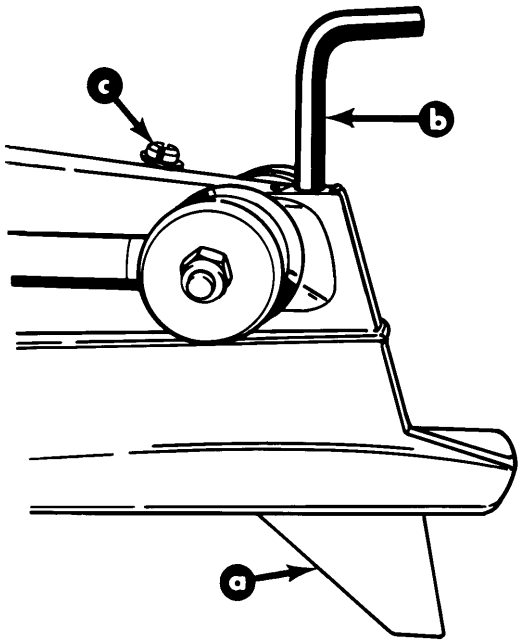
a - Locknuts (One Each Side)
b - Locknut



23263

c - Locknuts
d - Allen Screw

9. Install trim tab and position according to marks made before disassembly. Torque to 23 lb. ft. (32 N·m). Reinstall plastic plug.

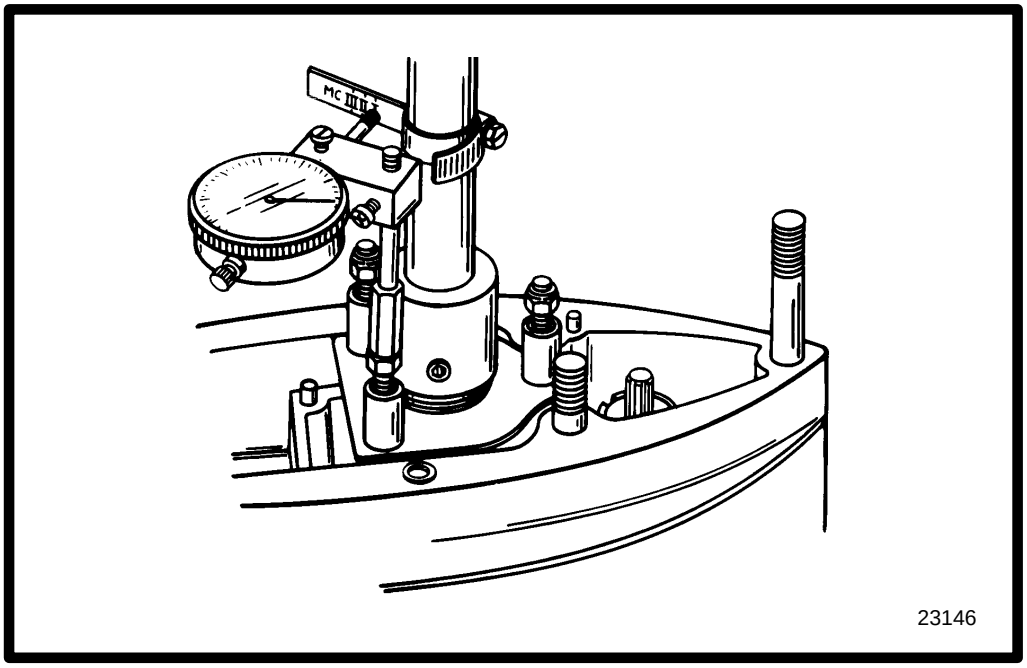


23253

a - Trim Tab
b - Allen Wrench
c - Plastic Plug

STERNDRIVE UNIT

3
B



23146

GEAR HOUSINGS
MR/ALPHA ONE/ALPHA ONE SS

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Identification

Early MerCruiser MR gear housings can be visually identified by the letter “A” stamped on the end of the propeller shaft. This mark was removed on later MR and Alpha One models. The gear housing can now be identified by the absence of a preload pin on the drive shaft (as was on “R” models).

The Alpha One SS is almost identical to the MR and Alpha One gear housings except that the Alpha One SS has a crescent shaped gear housing and the drive shaft is shorter. Service procedures however, are identical.

Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Nuts-Water Pump Body	90		10
Screw-Water Pump Body	20-30		2-3
Nut-Pinion Gear		60-80	81-108
Screw-Gear Housing To Drive Shaft Housing		28	38
Nuts-Gear Housing To Drive Shaft Housing		35	47
Screw-Trim Tab		23	31
Bushing-Shift Shaft		50	68
Retainer-Bearing Carrier		210	285
Driveshaft-Bearing Retainer		100	130

Shimming Specifications

Location	Specification
Forward Gear Backlash	.017-.028 in. (0.43-0.71 mm)
Reverse Gear Backlash	.028-.052 in. (0.71-1.32 mm)
Pinion Gear Height	.025 in. (0.64 mm)

Lubricants/Sealers/ Adhesives

Description	Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A2
3M Brand Adhesive	92-86166-1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Quicksilver Special Lubricant 101	92-79214A1
Quicksilver High Performance Gear Lube	92-816026A1
Loctite 27131	92-809820

Special Tools

Description	Part Number
Backlash Indicator Rod	91-53456
Bearing Carrier Retainer Wrench	91-61069
Bearing Preload Tool	91-44307 A1
Belleville Washer	12-54048
Dial Indicator	91-58222 A1
Dial Indicator Holding Tool	91-89897
Drive Shaft Nut Wrench	91-56775
Drive Shaft Tapered Bearing Driver	91-87119
Driver Cup	91-34379
Driver Cup	91-36577
Drive Shaft Bearing Retainer Tool	91-43506
Needle Bearing Driver	91-33491
Oil Seal Driver	91-31108
Oil Seal Driver	91-44110
Pinion Gear Shimming Tool	91-56048
Pinion Nut Adaptor	91-61061 A3
Puller Bolt	91-85716
Puller Jaws	91-46086 A1

Special Tools (continued)

Description	Part Number
Shift Shaft Bushing Tool	91-31107
Slide Hammer Puller	91-34569 A1
Torque Wrench - Lb. In.	91-66274
Universal Bearing Removal and Installation Tool	91-31229 A7
Bearing Adaptor	91-37263
Bearing Driver	91-52393
Bearing Driver	91-32336
Bearing Driver Rod	91-37323
Bearing Installation Tool	91-38628
Collar	91-30366
Driver Head	91-36569
Driver Head	91-37311
Driver Head	91-37312
Nut	11-24156
Pilot Washer	91-36571
Pilot Washer	91-37324
Pilot Washer	91-37350
Plate	91-29310
Puller Head	91-36379
Puller Rod	91-37229
Puller Rod Head	91-32325
Roller Bearing Removal and Installation Tool	91-37292
Washer	12-34961
Puller Rod	91-52394
Universal Puller Plate	91-37241
Guide Plate	91-816243
Bearing Cup Installation Tool	91-18605 A2
Shift Shaft Tool	75104 A7
Stud Adaptor	91-13948

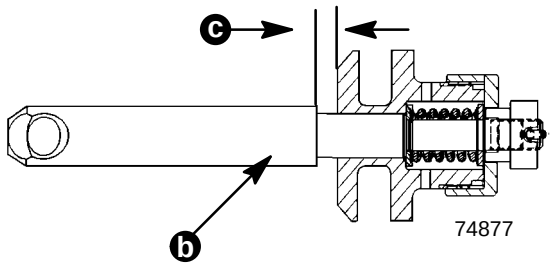
Special Information

⚠CAUTION

Avoid damage to sterndrive unit. Drive unit damage will occur if Later Style parts are intermixed with Earlier Style parts.

Shift Spool Assembly

The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool is sold as a whole assembly and can be used when replacing the earlier style. The end play for the spool will remain the same as the earlier models [.002-.010 in. (.051-.254 mm)].



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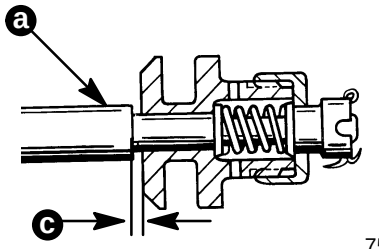
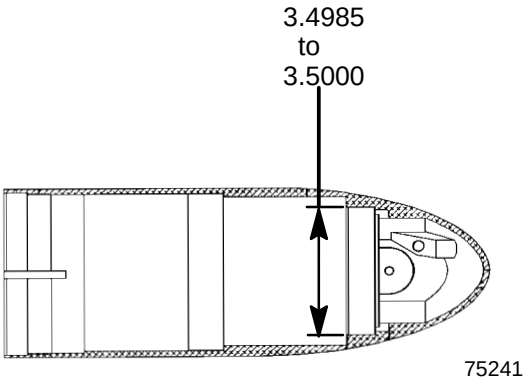


75219

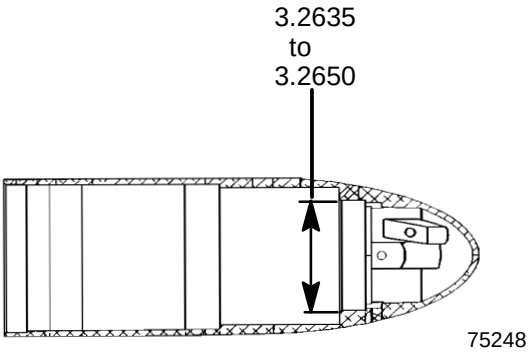
a - Earlier Style Shift Spool Assembly
b - Later Style Shift Spool Assembly
c - Measure End Play Here At Gap

Forward Gear Bearing Bore

The later style forward gear bearing bore is smaller (3.2635 - 3.2650 in.) than the earlier style (3.4985 to 3.5000 in.) This slightly smaller bearing bore for the forward gear bearing adaptor is approximately 1/4 in. (6 mm) smaller.

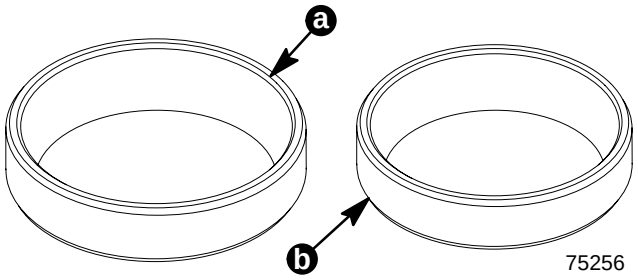


Earlier Style Forward Gear Bore (Prior to S/N 0F680153)



Later Style Forward Gear Bore (S/N 0F680154 and Above)

The later style bearing cup is thinner and has a smaller diameter than the earlier style.



a - Earlier Style Gear Bearing Cup 3.500 in. diameter (Prior To S/N 0F680153)

b - Later Style Gear Bearing Cup 3.265 in. diameter (S/N 0F680154 And Above)

The tables on the following pages list items that have been affected by the change.

The following is a supersession list to use when ordering the MCI or Alpha One lower gear housing as a **complete assembly** for replacement of the original lower unit.

Gear Housing Complete Supersession Listing				
Models	**Ratio**	**(Original) Gear Housing Assy Complete**	**Superseded by**	**Serial No. Range**
120	1.98:1	1623-5356A20	1623-8951A43	4893635 and up
140	1.98:1	1623-5356A20	1623-8951A43	4893635 and up
165	1.65:1	1623-5356A20	1623-8951A43	4890460 and up
470	1.84:1	1623-5356A20	1623-8951A43	4893835 and up
485	1.84:1	1623-5356A20	1623-8951A43	4893835 and up
225 - S	1.50:1	1623-5356A3	1623-8951A43	3856268 thru 4200499
228	1.50:1	1623-5356A3	1623-8951A43	4782330 and up
228	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
233	1.32:1	1623-8951A2	1623-8951A43	4200500 and up
250	1.32:1	1623-5356A3	1623-8951A43	4791300 and up
250	1.32:1	1623-8951A2	1623-8951A43	4791300 and up
260	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
888	1.50:1	1623-4110A6	1623-8951A43	3784374 and below
888	1.50:1	1623-4110A13	1623-8951A43	3784375 thru 3909577
888	1.50:1	1623-5356A3	1623-8951A43	3909578 and up
898	1.50:1	1623-8951A2	1623-8951A43	4782330 and up
898	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
470	1.84:1	1623-5356A3	1623-8951A43	4208730 and up
470	1.84:1	1623-8951A2	1623-8951A43	4208730 and up
R	ALL	1623-5356A20	1623-8951A43	6225577 and up
MR	ALL	1623-5356A20	1623-8951A43	6225577 and up
Alpha One	ALL	1623-8951A23	1623-8951A43	6225577 and up
Alpha One	ALL	1623-8951A14	1623-8951A43	6225577 and up

The following is a supersession list to use when ordering the **Gear Housing Only** for replacement of the original lower unit.

Gear Housing Only Supersession List				
Models	**Ratio**	**(Original) Gear Housing Only**	**Superseded by**	**Serial No. Range**
120	1.98:1	1623-5356A4	None Required	4893635 and up
140	1.98:1	1623-5356A4	None Required	4893635 and up
165	1.65:1	1623-5356A4	None Required	4890460 and up
470	1.84:1	1623-5356A4	None Required	4893835 and up
470	1.84:1	1623-5356A4	None Required	4208730 and up
470	1.84:1	1623-5356A4	None Required	4208730 and up
485	1.84:1	1623-5356A4	None Required	4893835 and up
225 - S	1.50:1	1623-5356A4	None Required	3856268 thru 4200499
228	1.50:1	1623-5356A4	None Required	4782330 and up
228	1.50:1	1623-5356A4	None Required	4898730 and up
233	1.32:1	1623-5356A4	None Required	4200500 and up
250	1.32:1	1623-5356A4	None Required	4791300 and up
250	1.32:1	1623-5356A4	None Required	4791300 and up
260	1.50:1	1623-5356A4	None Required	4898730 and up
888	1.50:1	1623-4110A3	1623-5356A4	3784374 and below
888	1.50:1	1623-4110A3	1623-5356A4	3784375 thru 3909577
888	1.50:1	1623-5356A4	None Required	3909578 and up
898	1.50:1	1623-5356A4	None Required	4782330 and up
898	1.50:1	1623-5356A4	None Required	4898730 and up
R	ALL	1623-5356A4	None Required	6225577 and up
MR	ALL	1623-8951A15	1623-8951A37	6225577 and up
Alpha One	ALL	1623-8951A27 (Black)	1623-8951A37	6225577 and up
Alpha One	ALL	1623-8951A14 (Oyster)	1623-8951A37	6225577 and up

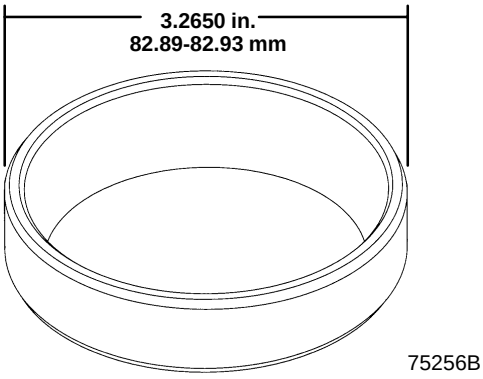
Before ordering a replacement **Gear Housing Only** for any of the previously listed units, you will need to look in the housing, at the cavity in front of the trim tab screw hole, for the casting number.

Order the appropriate housing number after determining the casting number.

GEAR HOUSING ONLY	
If Casting Number:	**Order Housing Number:**
1623-8950C 2	1623-8951A37
1623-8266C	1623-5356A4
1623-815822C 3	1623-815822A30

NOTE: *All of the numbers listed above are on the parts Micro-Fiche card.*

The 1623-815822A6 Gear Housing Only supersedes to 1623-815822A30. The A30 housing includes one 31-828439A2 forward gear bearing that allows you to install the 17/28 gears and the 14/28 gears into the new housing which has a 3.2635-3.2650 inch O.D. (82.89-82.93 mm) forward gear bearing bore.



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Bearing Cup 31-828439A2

When Ordering Gear Housing:	FWD. Gear Bearing Supersedes To:	Current Part Number:
1623-8951A27 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	1623-8951A37 3.2635-3.2650 in. O.D. (82.89-82.93 mm) Fwd. Gr. Brg.
1623-815822A6 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	1623-815822A30 3.2635-3.2650 in. O.D. (82.89-82.93 mm) Fwd. Gr. Brg.

When Ordering Gear Housing:	Along With:	Gear Set	Also Requires:	Forward Gear Bearing
1623-8951A27 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	43-828072A2 or 43-828072A3 (13/21)	➔	31-30894A1 3.2635-3.2650 in. OD. (82.89-82.93 mm) Fwd. Gr. Brg.
1623-815822A6 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	43-828072A2 or 43-828072A3 (13/21)	➔	31-30894A1 3.2635-3.2650 in. OD. (82.89-82.93 mm) Fwd. Gr. Brg.

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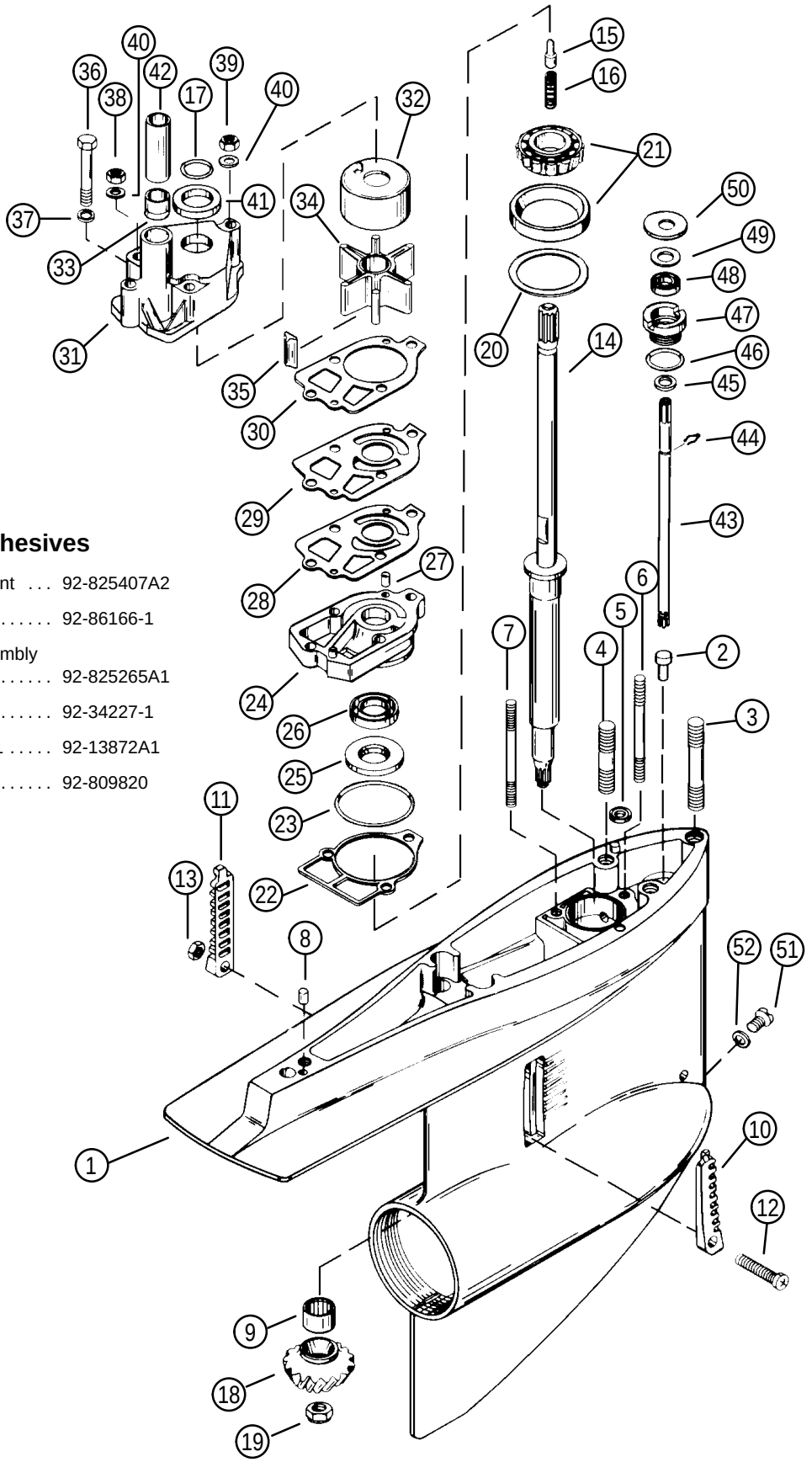
MR/Alpha One Gear Housing

Torque Specifications

- **a** 60-80 lb. ft. (81-108 N·m)
- **b** 30-lb. in. (3-5 N·m)
- **c** 60-80 lb. in. (6.8-9 N·m)
- **d** 28 lb. ft. (38 N·m)
- **e** 35 lb. ft. (47 N·m)
- **f** 23 lb. ft. (31 N·m)
- **g** 50 lb. ft. (68 N·m)
- **h** 210 lb. ft. (285 N·m)
- **i** 30-50 lb. in. (3.39-5.65 N·m)
- **J** 100 lb. ft. (130 N·m)

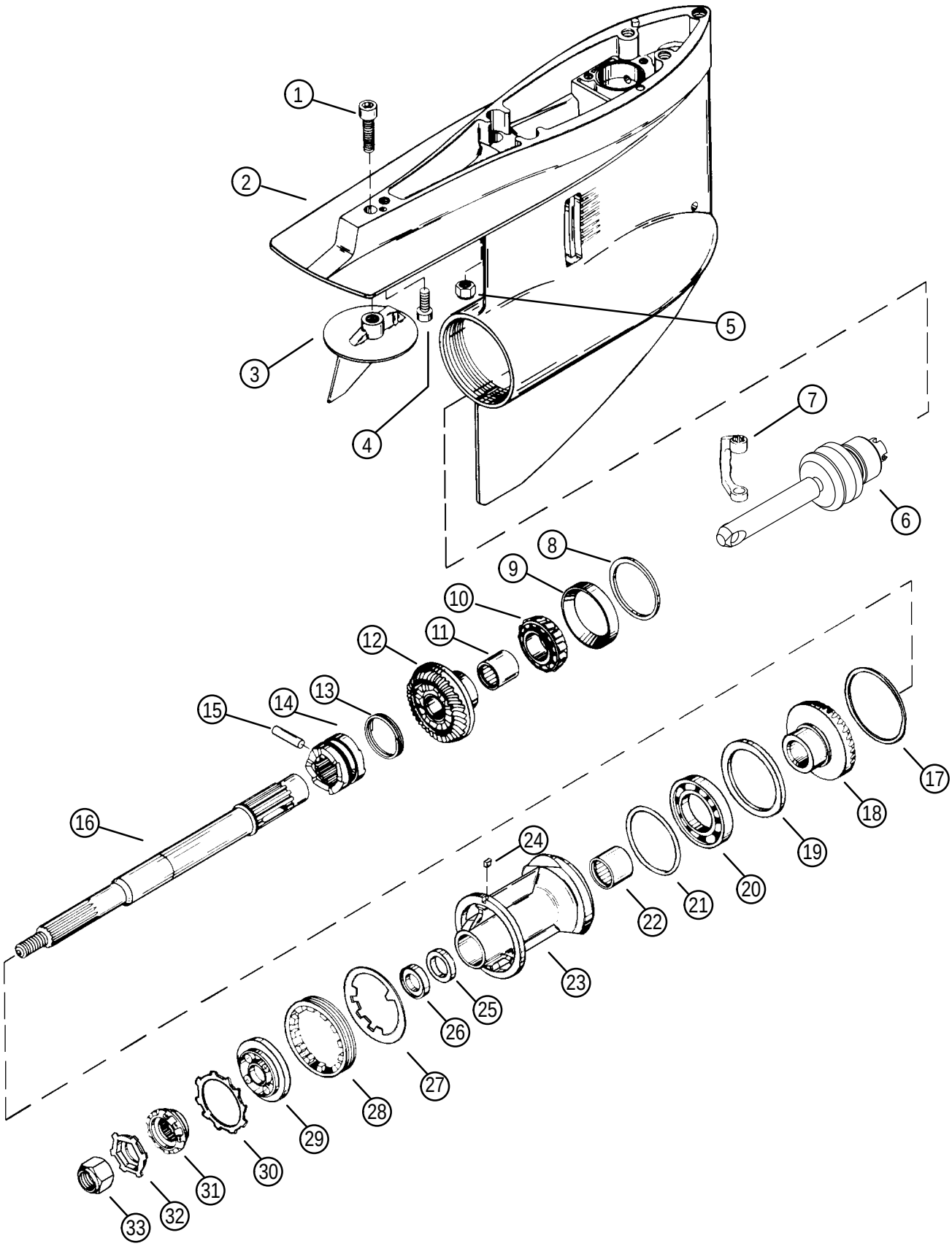
Lubricants/Sealers/Adhesives

A	Quicksilver 2-4-C Marine Lubricant	92-825407A2
B	3M Brand Adhesive	92-86166-1
C	Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
D	Quicksilver Perfect Seal	92-34227-1
E	Quicksilver Special Lubricant 101	92-13872A1
F	Loctite 27131	92-809820



75743

1 - Gear Housing Assembly
2 - Shift Crank Pin
3 - Gear Housing Stud
4 - Gear Housing Stud
5 - Gear Housing Seal
6 - Water Pump Stud
7 - Water Pump Stud
8 - Dowel Pin
9 - Roller Bearing
10- Water Pickup Insert
11- Water Pickup Insert
12- Insert Screw
13- Insert Nut
14- Drive Shaft Assembly
15- Drive Shaft Pin
16- Compression Spring
17- O-ring
18- Gear Set (Pinion and Forward Gear)
19- Nut
20- Shim
21- Tapered Roller Bearing Assembly
22- Gasket
23- O-ring
24- Water Pump Base Assembly
25- Oil Seal
26- Oil Seal
27- Dowel Pin
28- Lower Gasket
29- Face Plate
30- Gasket
31- Water Pump Body Assembly
32- Water Pump Insert
33- Rubber Seal
34- Impeller
35- Key
36- Screw
37- Washer
38- Nut
39- Nut
40- Washer
41- Rubber Ring
42- Guide Sleeve
43- Lower Shift Shaft
44- Retaining Clip
45- Washer
46- O-ring
47- Bushing Assembly
48- Oil Seal
49- Washer
50- Washer
51- Screw
52- Washer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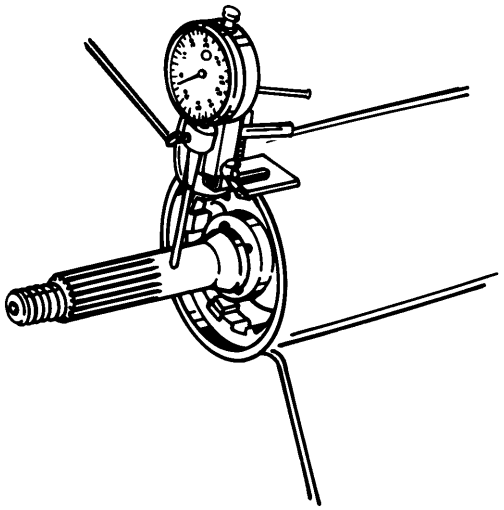
75744

1 - Trim Tab Screw
2 - Gear Housing Assembly
3 - Trim Tab Assembly
4 - Screw
5 - Nut
6 - Shift Spool Assembly
7 - Shift Crank
8 - Shim
9 - TaperedRoller Bearing
10- Tapered Roller Bearing
11- Forward Gear Roller Bearing
12- Forward Gear
13- Cross Pin Retainer Spring
14- Clutch
15- Cross Pin
16- Propeller Shaft
17- Shim
18- Reverse Gear
19- Thrust Ring
20- Ball bearing
21- O-ring
22- Roller Bearing
23- Bearing Carrier
24- Key
25- Oil Seal
26- Oil Seal
27- Tab Washer
28- Gear Housing Cover
29- Thrust Hub
30- Lockwasher
31- Spline Washer
32- Tab Washer
33- Propeller Nut

Pre-Disassembly Inspection

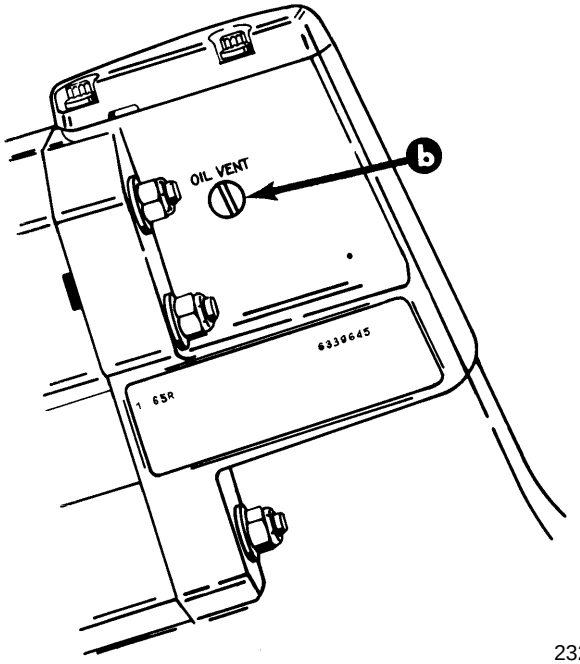
1. Check propeller shaft for side to side movement, as follows:
   a. Position dial indicator on propeller shaft.
   b. Push propeller shaft to one side and zero the dial indicator.
   c. Move propeller shaft to opposite side while observing dial indicator. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than .003 in. (0.08 mm) indicates one of the following:
      - Worn propeller shaft bearings
      - Improper propeller shaft preload
2. Check for a bent propeller shaft, as follows:
   a. Rotate propeller shaft while observing dial indicator. If deflection is more than .005 in. (0.127 mm), a bent propeller shaft is indicated.



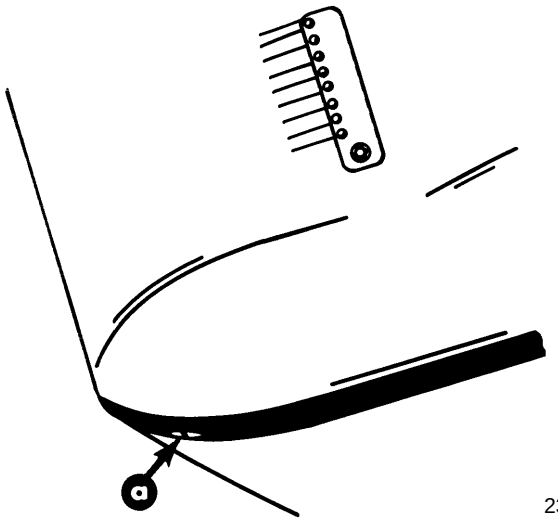
22086

Separate Drive Shaft Housing From Gear Housing

1. Tilt drive unit at a 45 degree angle, remove fill/drain screw; then remove oil vent screw. Allow drive unit to drain completely.



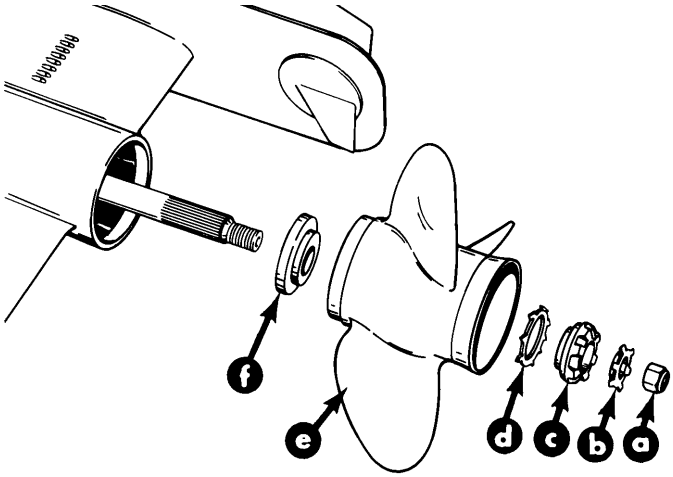
23263



23266

a - Fill/Drain Screw
b - Sealing Washer

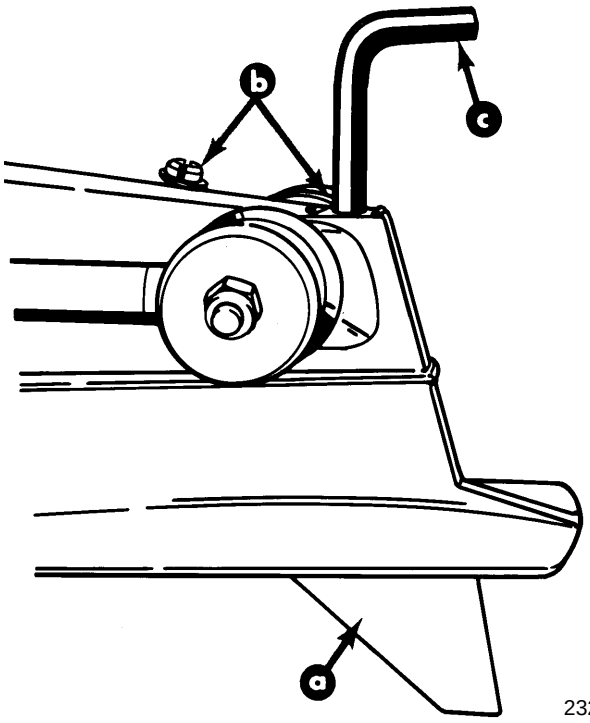
2. Remove propeller.



22074

a - Propeller Nut
b - Tab Washer
c - Spline Washer
d - Continuity Washer
e - Propeller
f - Thrust Hub

3. Mark trim tab position with a piece of tape; then remove trim tab.

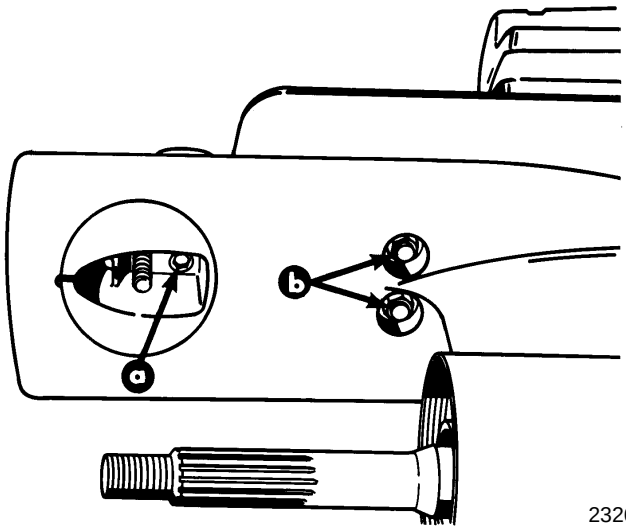


23253

a - Trim Tab
b - Plastic Plug (From Access Hole)
c - 3/8 in. Allen Wrench

4. Remove gear housing as follows:

a. Remove allen screw and locknuts from bottom side of gear housing.



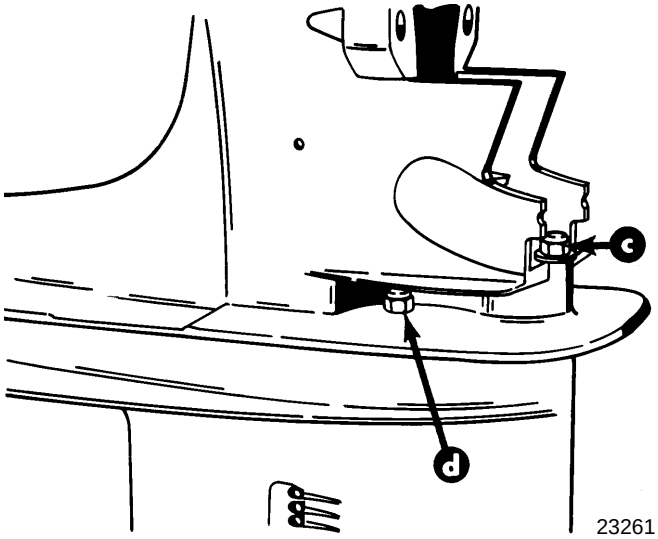
23263

a - Allen Screw (In Trim Tab Cavity)
b - Locknuts

b. Remove locknut from front side of drive shaft housing.

c. Loosen locknuts (one on each side of gear housing). DO NOT attempt to remove one nut before opposite side is loosened sufficiently or drive shaft housing could be damaged.

d. Pull gear housing away from drive shaft housing as far as nuts will allow. Remove loosened nuts.



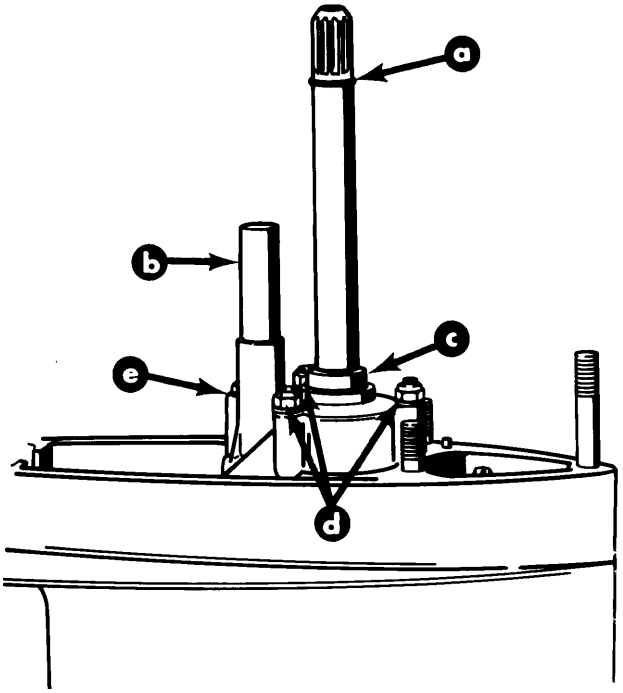
23261

c - Locknut (Top Front)
d - Locknuts (One Each Side)

Gear Housing Disassembly

NOTE: *If O-ring remains lodged between upper drive shaft seals (in drive shaft housing), be sure to remove O-ring or reassembly will be impaired.*

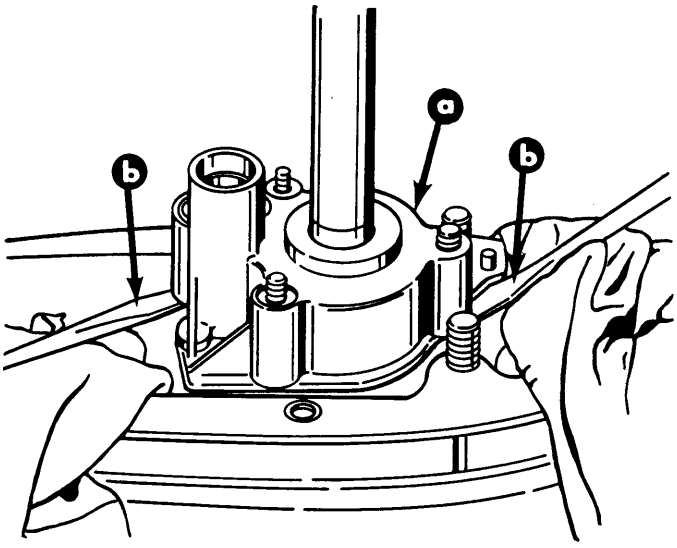
1. Remove components shown.



23266

a - O-ring
b - Water Tube
c - Rubber Centrifugal Slinger
d - Self-Tapping Screw

2. Carefully lift water pump body from gear housing.

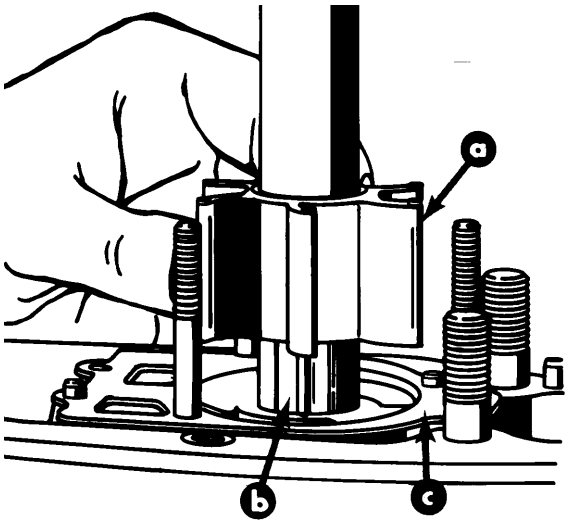


23349

a - Water Pump Body
b - Pry Bars

3. Remove water pump impeller.

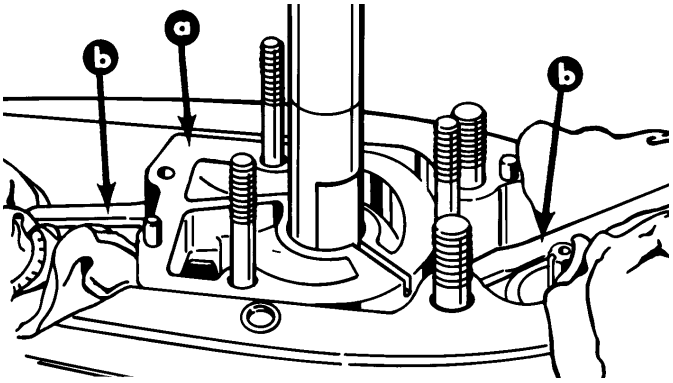
NOTE: *It may be necessary to use a punch and hammer to drive impeller upward on drive shaft. In extreme cases, it may be necessary to split hub of impeller with hammer and chisel.*



23356

a - Water Pump Impeller
b - Drive Key
c - Water Pump Face Plate And Gaskets
(One On Each Side Of Face Plate)

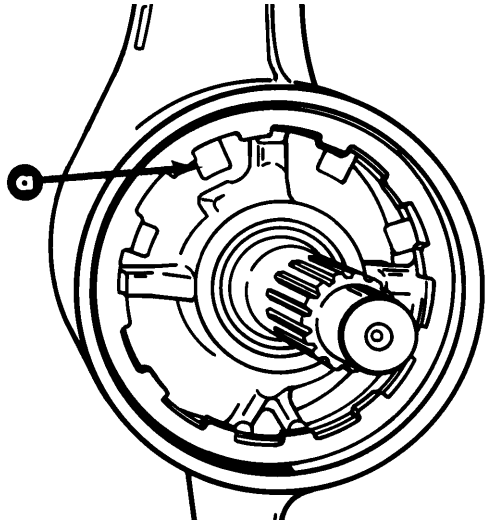
4. Remove water pump base from gear housing.



23356

a - Water Pump Base
b - Pry Bars

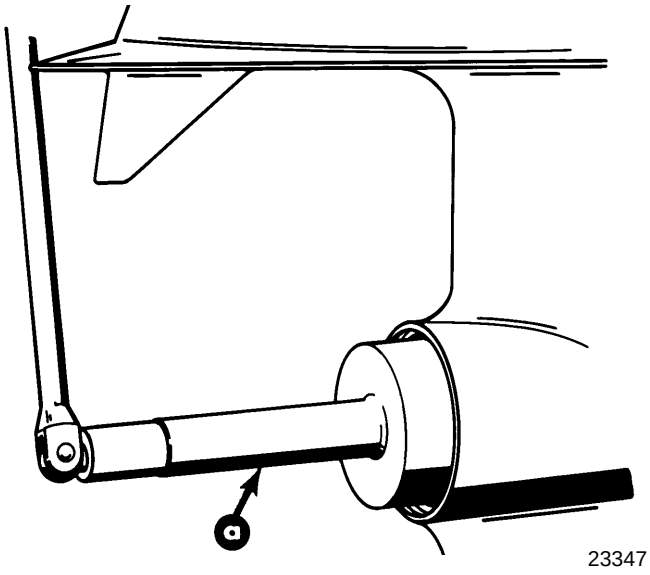
5. Straighten tabs on bearing carrier tab washer.



a - Tab On Tab Washer

6. Remove bearing carrier retainer following Step a or b as follows:

   a. Remove bearing carrier retainer using bearing carrier retainer wrench (P/N 91-61069).

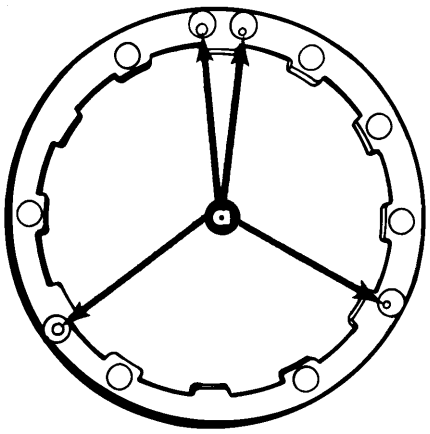


a - Bearing Carrier Retainer Wrench

⚠CAUTION

DO NOT drill into gear housing retainer threads if using following procedure for removing retainer.

   b. If retainer is corroded in place, drill 4 holes in retainer and fracture retainer with a chisel. Pry out remaining segments.



a - Drilled Holes

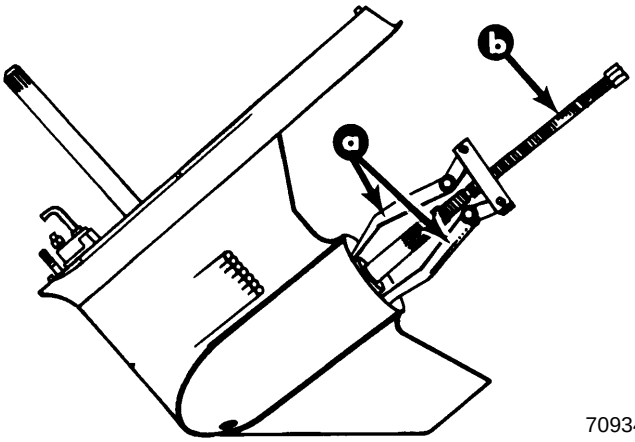
7. Remove bearing carrier following step “a or b” as follows:

⚠CAUTION

On Earlier Style Units - DO NOT pull on the bearing carrier outer ring, as damage to the carrier will result.

a. **On Earlier Style Units** - Pull the bearing carrier from the gear housing by pulling on the inner bosses located on the center area by the oil seals.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



70934

Earlier Style Units

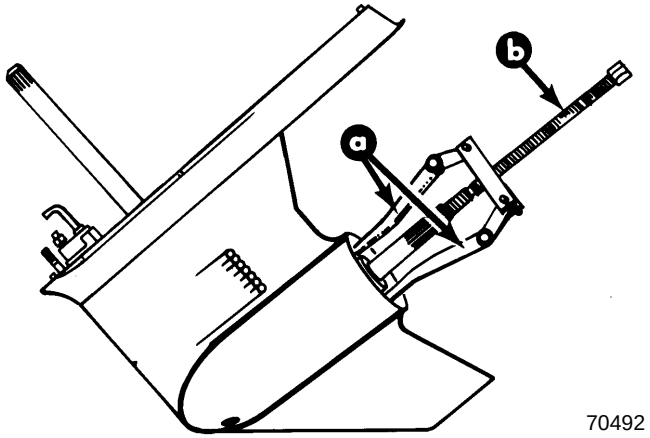
a - Puller Jaws (P/N 91-46086A1)
b - Puller Bolt (P/N 91-85716)

⚠CAUTION

On Later Style Units - DO NOT pull on the bearing carrier inner ring, as damage to the carrier will result.

b. **On Later Style Units** - Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*

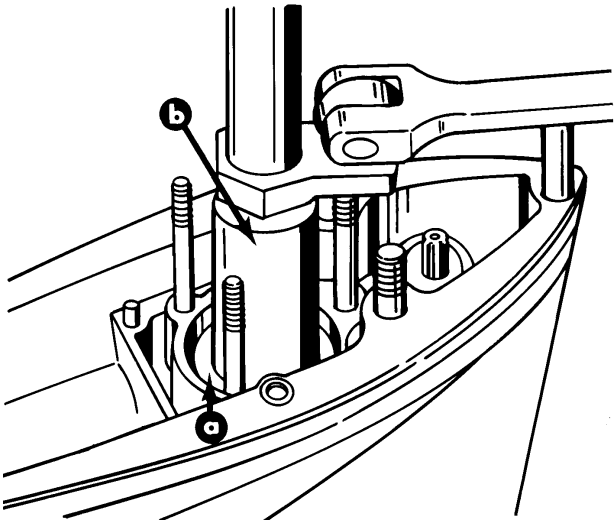


70492

Later Style Units

a - Puller Jaws (P/N 91-46086A1)
b - Puller Bolt (P/N 91-85716)

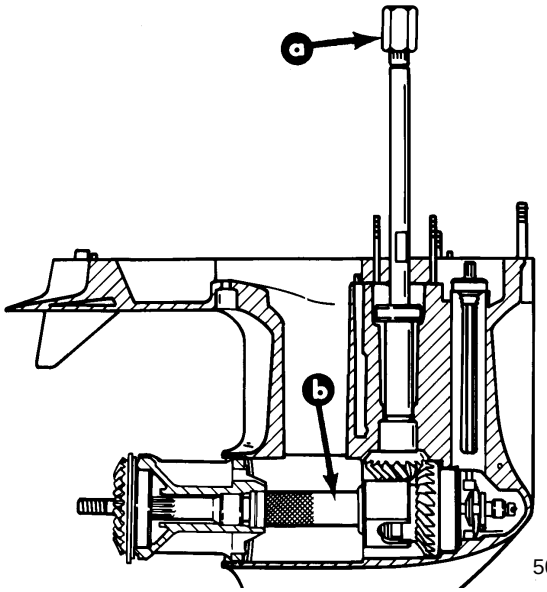
8. Loosen drive shaft bearing retainer 2 or 3 turns. DO NOT remove at this time.



23347

a - Bearing Retainer
b - Bearing Retainer Wrench (91-43506)

9. Remove drive shaft pinion nut as follows:
   a. Place drive shaft nut wrench over drive shaft splines.
   b. Pull up on the drive shaft;then, place the pinion nut adaptor over the propeller shaft with the “MR” slot facing the pinion gear, then slide the pinion nut adaptor onto the pinion gear nut.
   c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
   d. Turn drive shaft counterclockwise to remove pinion nut.

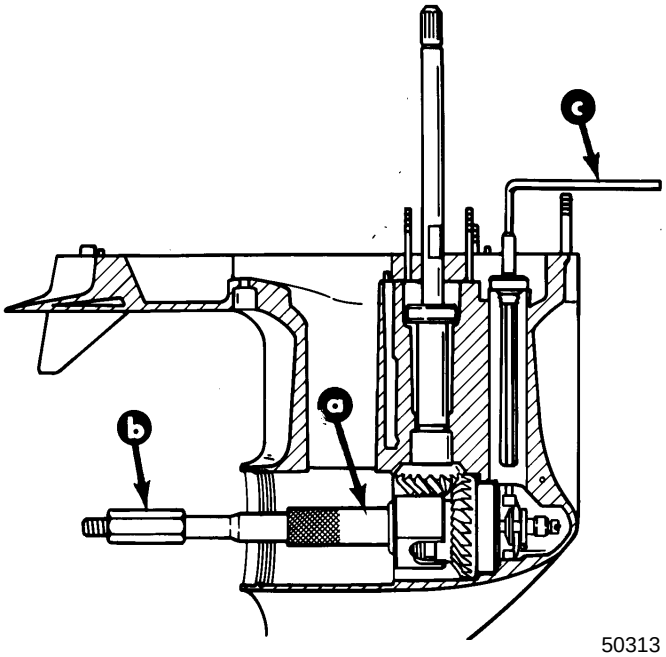


50313

a - Drive Shaft Nut Wrench (91-56775)
b - Pinion Nut Adaptor (91-61067A2)

   e. **If Drive Shaft is Broken:** Place pinion nut adaptor over propeller shaft and onto pinion nut. Shift gear housing into forward gear. Turn propeller shaft counterclockwise to turn gears, thus removing pinion nut.

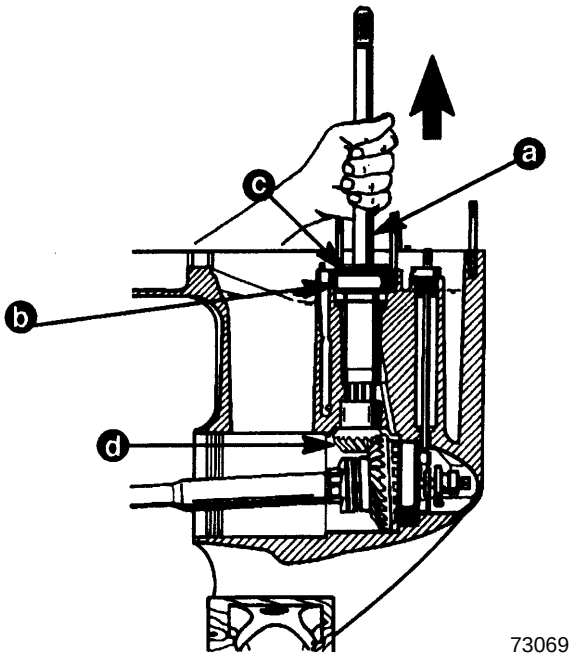
NOTE: *Propeller Shaft Tool 91-61077 is included with pinion nut adaptor 91-61067A2.*



50313

a - Pinion Nut Adaptor (91-61067A2)
b - Propeller Shaft Tool (91-61077)
c - Turn Clockwise (For Forward Gear)

10. Remove drive shaft and all components as shown.
    a. Completely unscrew the driveshaft bearing retainer.
    b. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counter-clockwise direction.
    c. Remove tools.

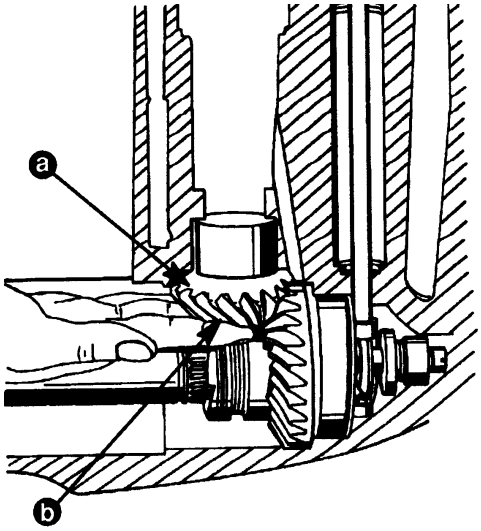


73069

a - Drive Shaft
b - Bearing Cup
c - Bearing Retainer
d - Pinion Nut

IMPORTANT: Pinion bearing rollers are free to fall out of outer bearing race once drive shaft is removed. Be careful not to loose rollers (18).

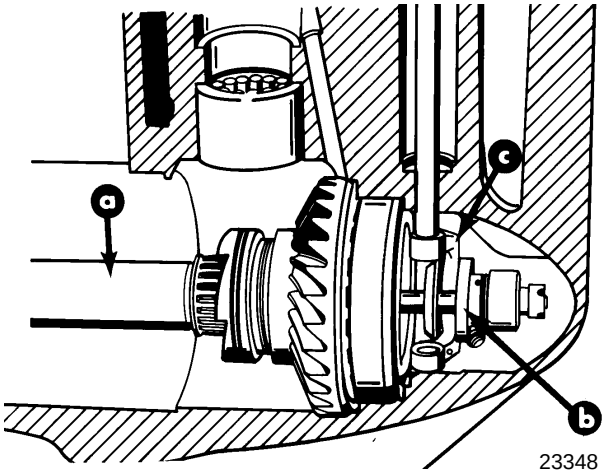
11. Remove pinion gear and anti-galling washer.



73868

a - Pinion Gear
b - Anti-Galling Washer (Hidden)

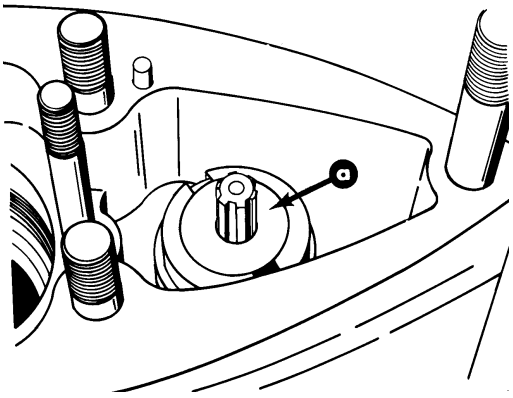
12. Remove propeller shaft and forward gear assembly. Move propeller shaft to left to disengage from shift spool.



23348

a - Propeller Shaft
b - Shift Spool
c - Shift Crank

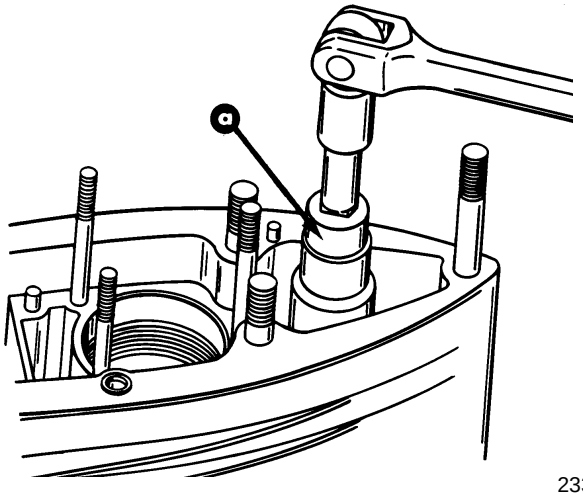
13. Remove shift shaft metal washer and rubber washer.



23354

a - Metal Washer And Rubber Washer (Under Metal Washer)

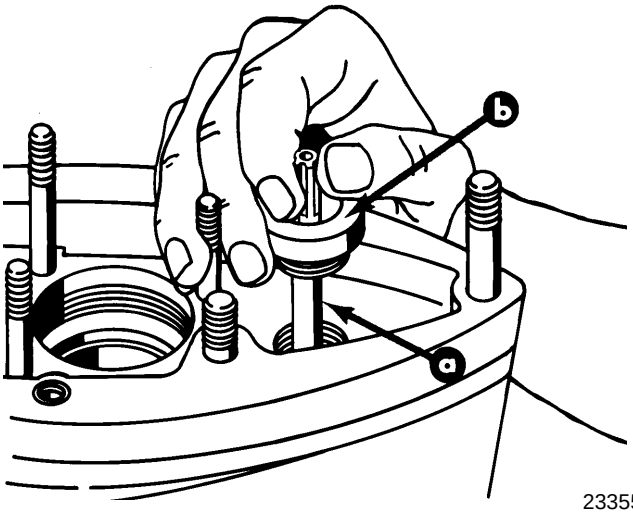
14. Loosen shift shaft bushing.



23354

a - Shift Shaft Bushing Tool (91-31107)

15. Lift shift shaft assembly and shift shaft bushing from gear housing. Remove shift crank from gear housing.



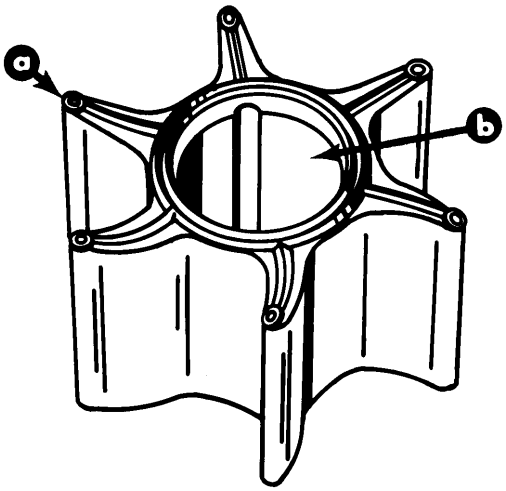
23355

a - Shift Shaft Assembly
b - Shift Shaft Bushing

Component Servicing

WATER PUMP INSPECTION

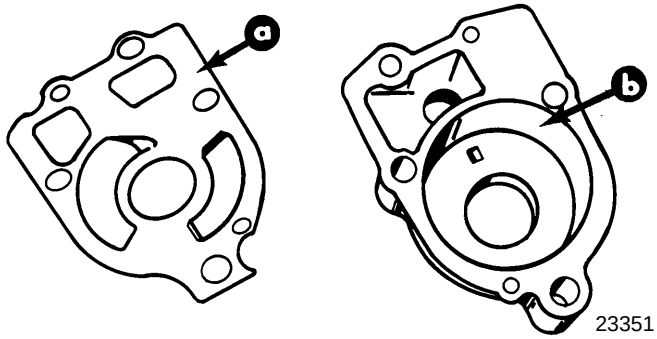
1. Check water pump impeller for wear on end of impeller blades and on top and bottom edge of blades.
2. Check for proper bonding between hub and impeller.
3. Replace impeller if blades have taken a set (hard and deformed).



50312

a - Water Pump Impeller
b - Hub (Changed From Aluminum To Fiber Hub)

4. Inspect water pump face plate and insert for roughness and grooves.
5. Replace parts if defects are found.

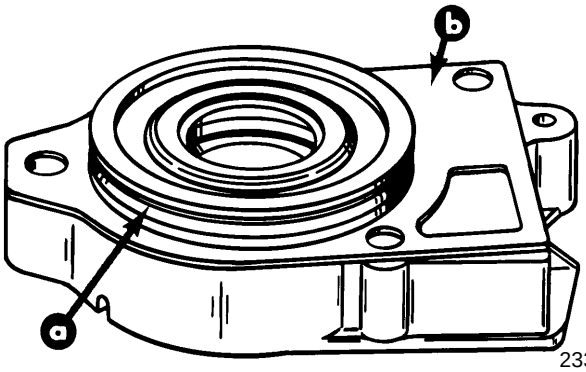


23351

a - Water Pump Face Plate
b - Insert

WATER PUMP DISASSEMBLY

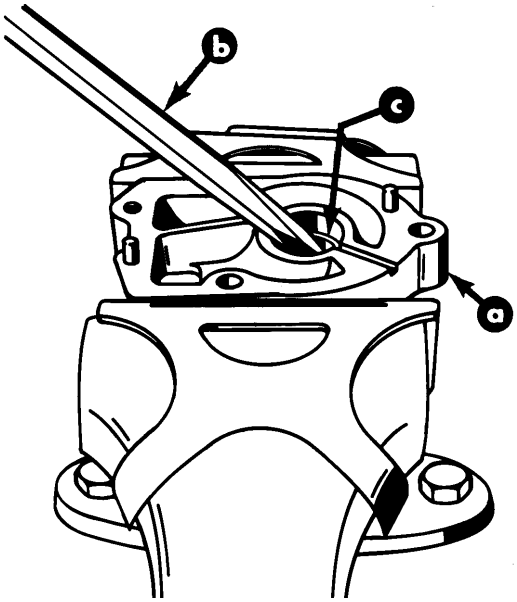
1. Remove water pump base O-ring and gasket.



23348

a - O-ring
b - Gasket

2. Remove water pump base oil seals.



23347

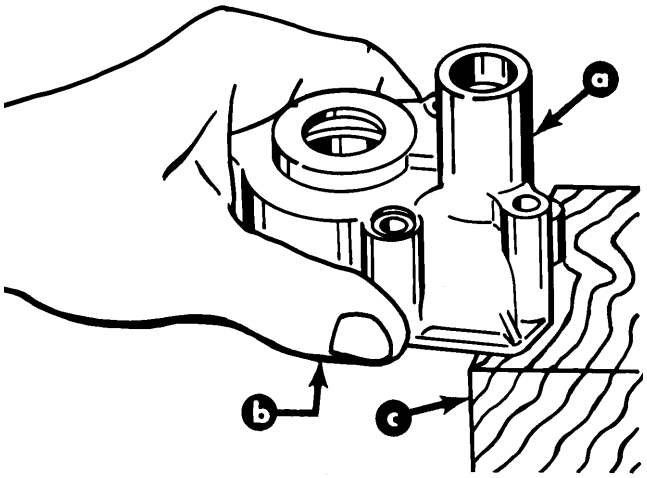
a - Water Pump Base
b - Screw Driver
c - Oil Seals (2)-Drive Out One At A Time

3. If water pump insert required replacement, follow Method “A” or “B” following.

NOTE: *Try Method “A” first. If insert cannot be removed following Method “A”, use Method “B”.*

METHOD “A”

Hold firmly onto water pump body, remove insert by squarely and firmly tapping body on a hard surface.

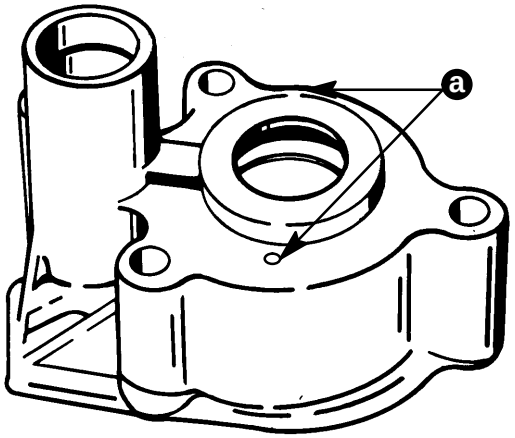


23355

a - Water Pump Body
b - Insert
c - Hard Surface (Wood Block)

METHOD “B”

Drill two 3/16 in. (5 mm) holes through water pump body - **DO NOT drill through insert.** Drive insert out of body, using punch and hammer.

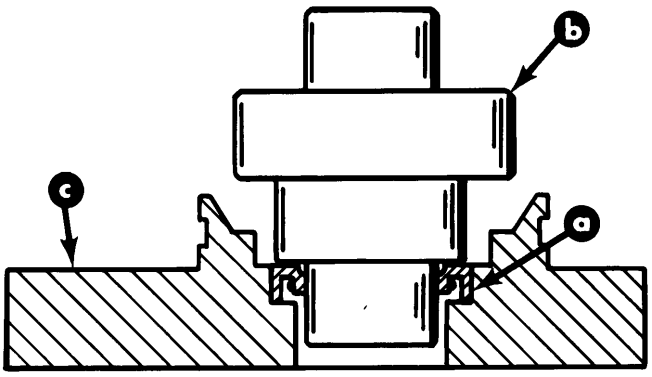


23351

a - 3/16 in. (5 mm) Holes

WATER PUMP REASSEMBLY

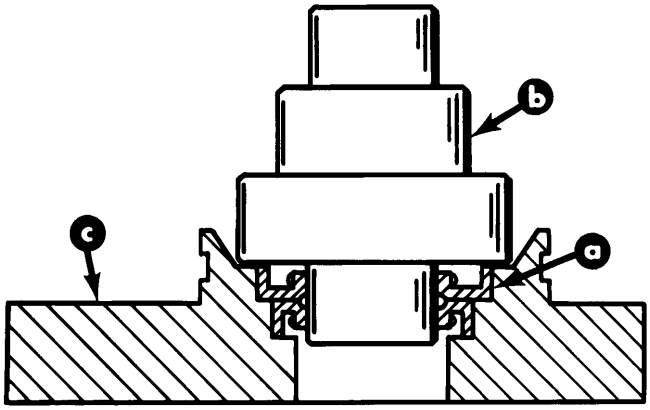
1. Press smaller diameter oil seal into water pump base from bottom, with lip of seal facing top of water pump base using oil seal driver.



23139

a - Oil Seal
b - Oil Seal Driver (91-44110)
c - Water Pump Base

2. Press larger diameter oil seal into water pump base from bottom, with lip of seal facing bottom of water pump base using oil seal driver.



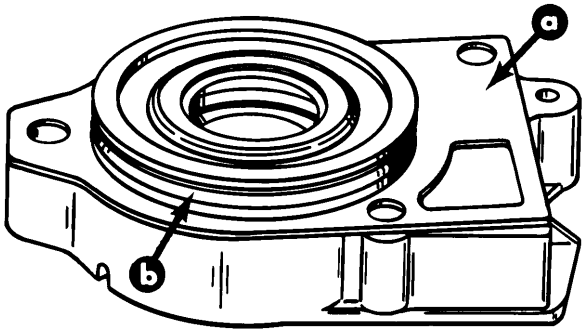
23139

a - Oil Seal
b - Oil Seal Driver (91-44110)
c - Water Pump Base

⚠ CAUTION

Water pump base gasket MUST BE installed correctly. A gasket incorrectly installed will block water pump base water passage. A blocked water passage will result in subsequent engine overheating damage.

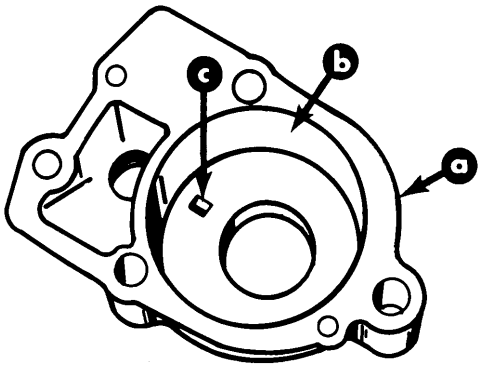
3. Install water pump base gasket and O-ring. Lubricate O-ring and lips of both seals with 2-4-C Marine Lubricant with Teflon.



23343

a - Gasket
b - O-ring

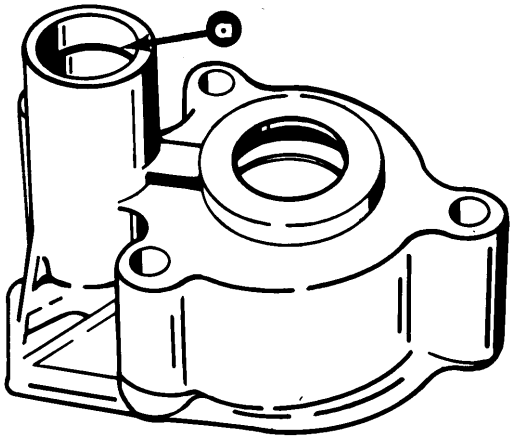
4. Install water pump insert into water pump as follows:
   a. Lubricate water pump insert outside diameter with Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal.
   b. Install insert into water pump body. Make sure that tab on insert enters locating recess in pump body.
   c. Remove all excess lubricant or sealer. DO NOT allow any excess sealer to remain inside insert or impeller could be damaged.



23351

a - Water Pump Body
b - Insert
c - Tab

5. Install water tube seal. Lubricate inside diameter with 2-4-C Marine Lubricant with Teflon.



23351

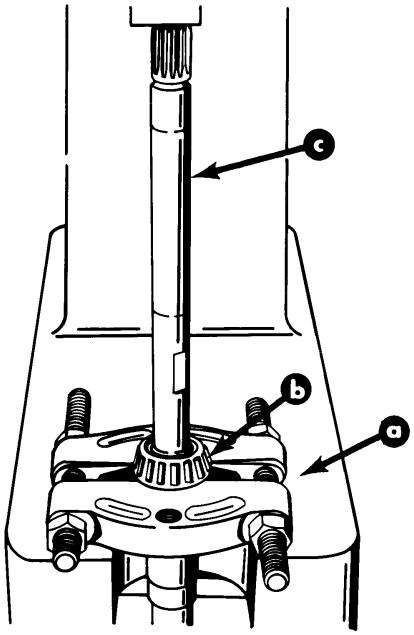
a - Water Tube Seal

DRIVE SHAFT AND PINION BEARING INSPECTION AND CLEANING

1. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on drive shaft. Replace bearing and bear- ing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.
2. The condition of the bearing surface on drive shaft at needle bearing location gives an indication of the condition of needle bearings. Replace needles and race as a set if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.
3. Inspect splines for worn or twisted condition. Replacement of drive shaft is necessary if either condition exists.
4. Inspect pinion gear for pitting, chipped or broken teeth, fractures and excessive or uneven wear.
5. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

DRIVE SHAFT DISASSEMBLY

1. Press tapered roller bearing from drive shaft using universal puller plate to support bearing (inner race).



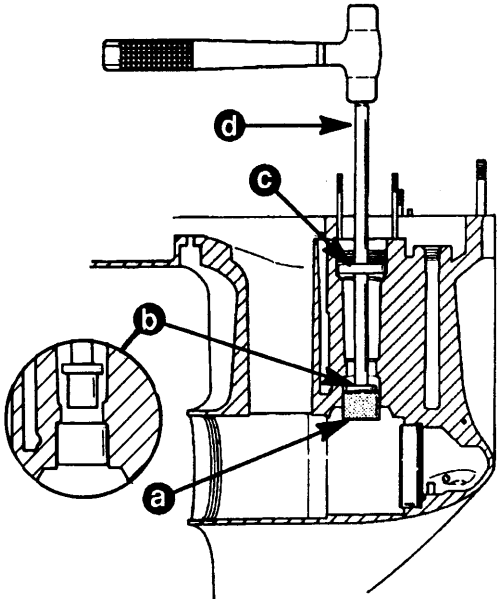
23349

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Drive Shaft

PINION BEARING REMOVAL

IMPORTANT: All needle bearings (18) MUST BE in place inside bearing race while driving pinion bearing from gear housing.

1. Remove pinion bearing using tools as shown.

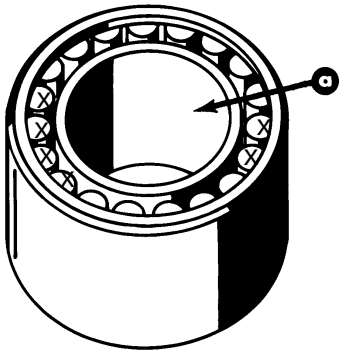


73875

a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

PINION BEARING INSTALLATION

1. If needle bearings have fallen over in casing, install needles using Needle Bearing Assembly Lubricant (92-825265A1) to help hold needles in place. If new bearing is being installed, leave cardboard shipping sleeve in place until installed and ready to install drive shaft.



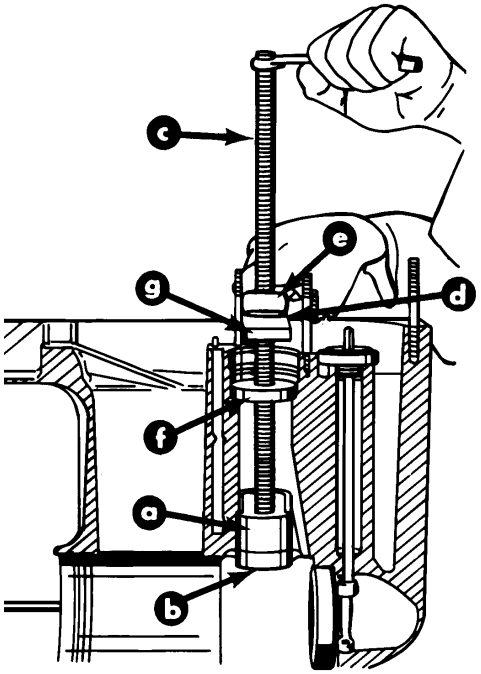
23351

a - Shipping Sleeve

2. Position bearing assembly over bearing installation tool, with lettered and numbered side up.

3. By way of propeller shaft cavity, place bearing into drive shaft bore.

4. Install bearing using tools as shown. Pull bearing up until it bottoms on shoulder inside bore.

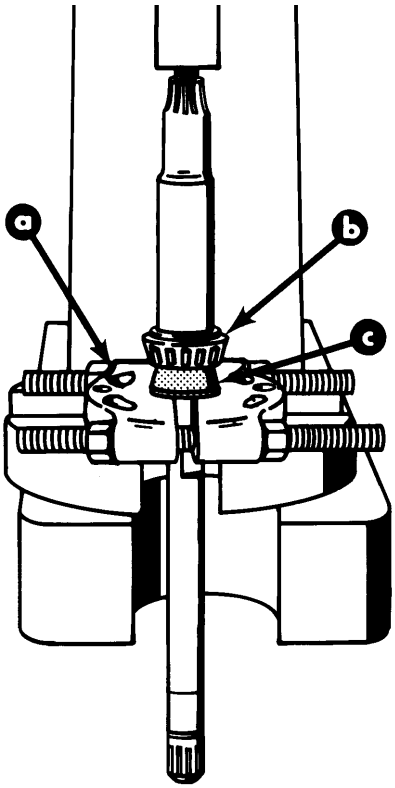


23350

a - Drive Shaft Pinion Bearing
b - Bearing Installation Tool (91-38628)
c - Puller Rod (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Plate (P/N 91-29310)

DRIVE SHAFT REASSEMBLY

1. Press tapered roller bearing onto drive shaft using universal puller plate and a suitable mandrel (old tapered roller bearing inner race). Ensure large O.D. faces pinion end of shaft.

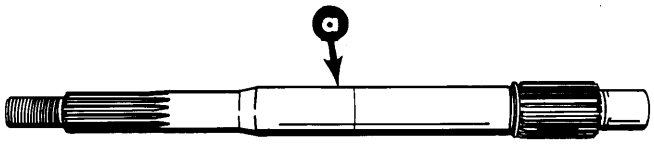


50314

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Suitable Mandrel

BEARING CARRIER, REVERSE GEAR AND RETAINER INSPECTION

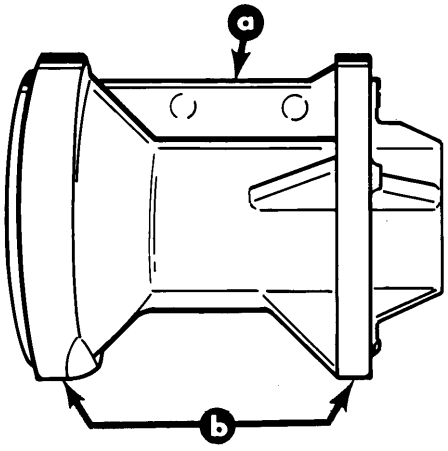
1. The condition of the propeller shaft bearing surface in the area of propeller shaft needle bearing is an indication of the condition of propeller shaft needle bearing. Replace bearing if surface is pitted, grooved, worn uneven, discolored from overheating or has embedded metal particles.



23355

a - Propeller Shaft Bearing Contact Area

2. Check bearing carrier for signs of corrosion, especially in area where bearing carrier mates with gear housing. If corrosion is evident, replace carrier.

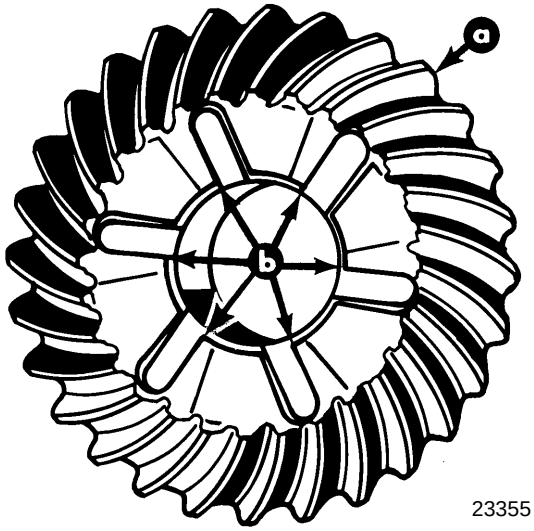


50314

a - Bearing Carrier
b - Mating Surfaces

3. Inspect reverse gear for pitting, chipped or broken teeth, hairline fractures, excessive wear or uneven wear.

4. Inspect clutch jaws for damage. Jaws must not be chipped or rounded off.

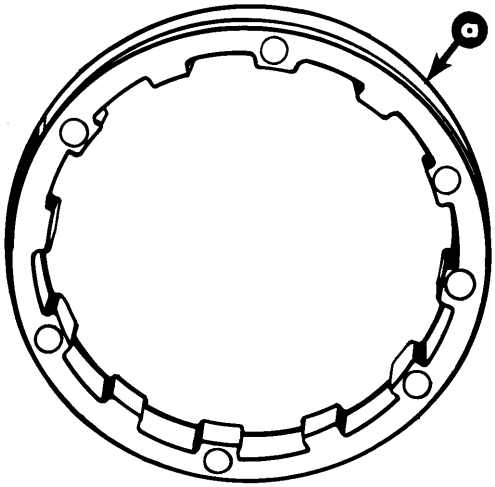


23355

a - Reverse Gear Teeth
b - Clutch Jaws

5. Check reverse gear bearing for excess movement or roughness when rotating.

6. Inspect bearing carrier retainer for cracks and/or broken corroded threads.

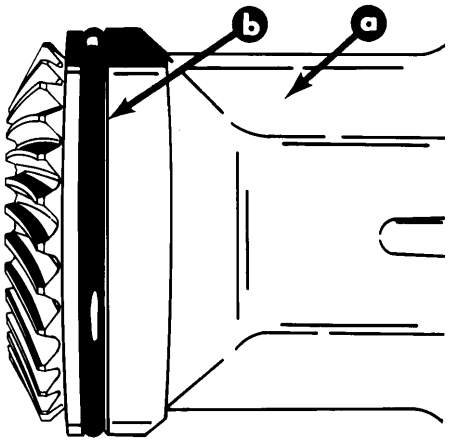


23356

a - Bearing Carrier Retainer

BEARING CARRIER AND REVERSE GEAR DISASSEMBLY

1. Remove O-ring from bearing carrier.



23354

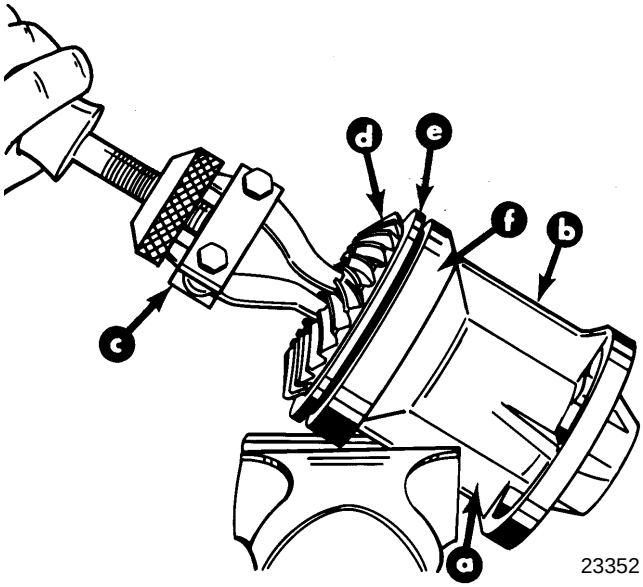
a - Bearing Carrier
b - O-ring

⚠CAUTION

Clamp on reinforcing rib of bearing carrier ONLY, or damage to carrier may result.

2. Place bearing carrier in vise, clamping on reinforcing rib.

3. Remove reverse gear, thrust ring and bearing as an assembly, using slide hammer puller.



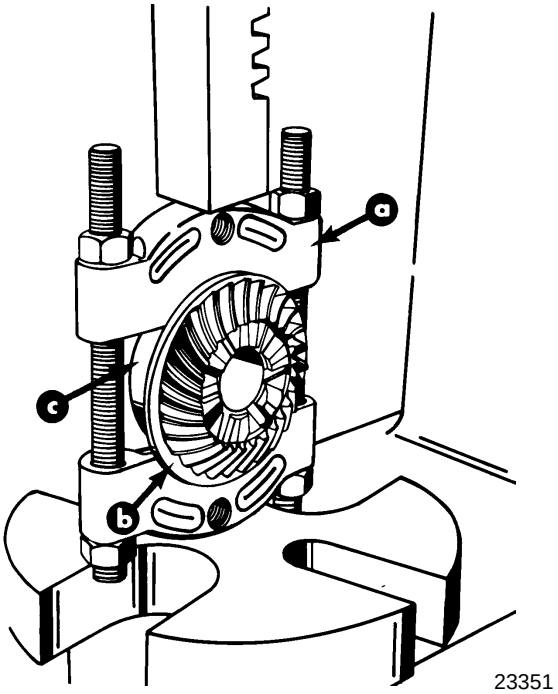
23352

a - Bearing Carrier Reinforcing Rib
b - Bearing Carrier
c - Slide Hammer Puller (P/N 91-34569A1)
d - Reverse Gear
e - Thrust Ring
f - Bearing (Not Seen)-Located In Carrier

IMPORTANT: Bearing MUST BE replaced if removed from gear.

4. Place universal puller plate between thrust washer and bearing as shown.

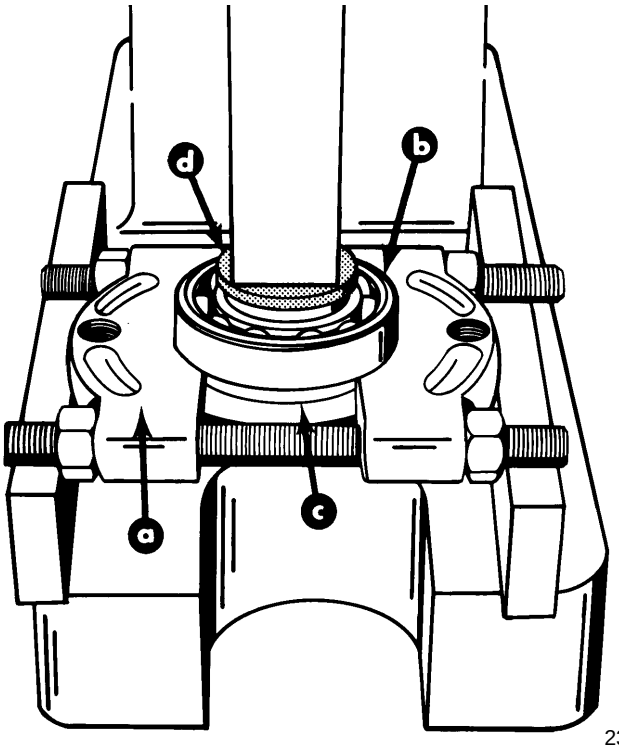
5. Press on plate until it bottoms.



23351

a - Universal Puller Plate (91-37241)
b - Thrust Washer
c - Bearing

6. Press bearing from reverse gear using universal puller plate to support bearing and pushing on gear with a suitable mandrel.

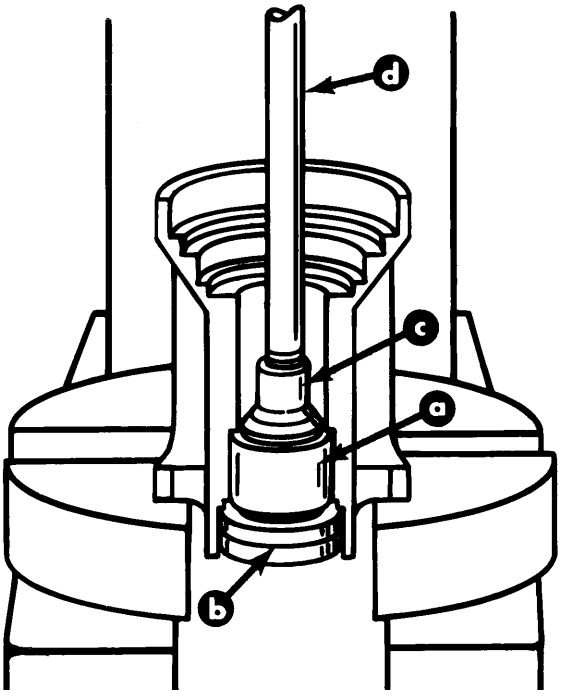


23351

a - Universal Puller Plate (91-37241)
b - Bearing
c - Gear
d - Suitable Mandrel

7. Perform step “a or b” as necessary.

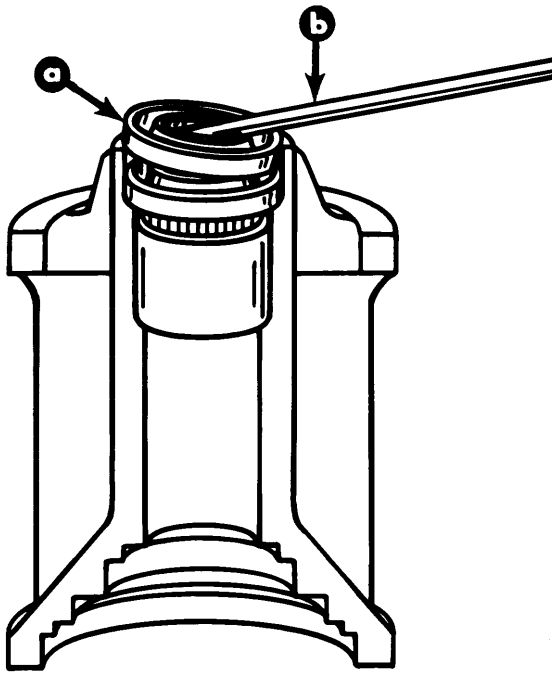
   a. **If Replacing Propeller Shaft Needle Bearing and Seals:** Remove needle bearing and seals with tools as shown.



23140

a - Needle Bearing
b - Oil Seals
c - Puller Head (91-36569)
d - Bearing Driver Rod (91-37323)

   b. **If Replacing Seals Only:** Remove oil seals. Be careful not to damage bore.

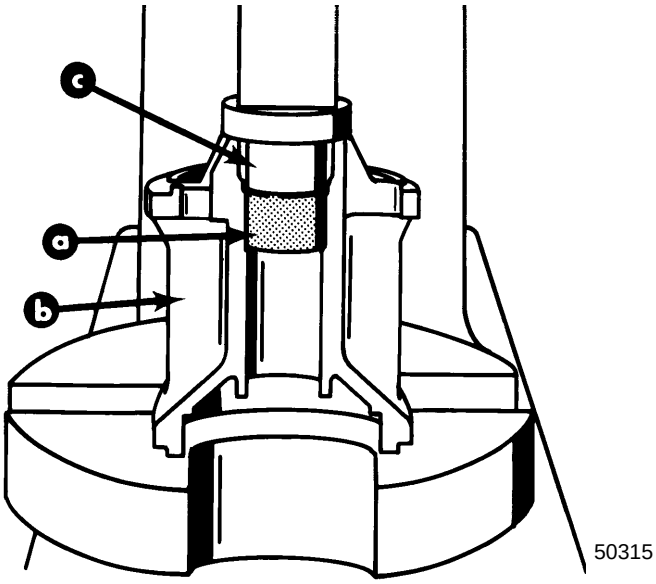


23140

a - Oil Seals
b - Pry Bar

BEARING CARRIER AND REVERSE GEAR REASSEMBLY

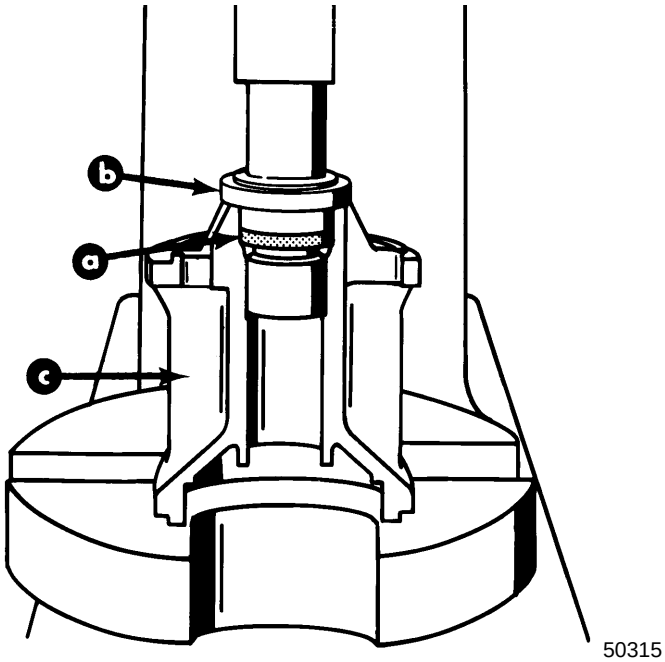
1. Press needle bearing into bearing carrier until tool bottoms on bearing carrier. Ensure numbered side of needle bearing faces seal end of carrier.



50315

a - Needle Bearing
b - Bearing Carrier
c - Bearing Driver (91-15755)

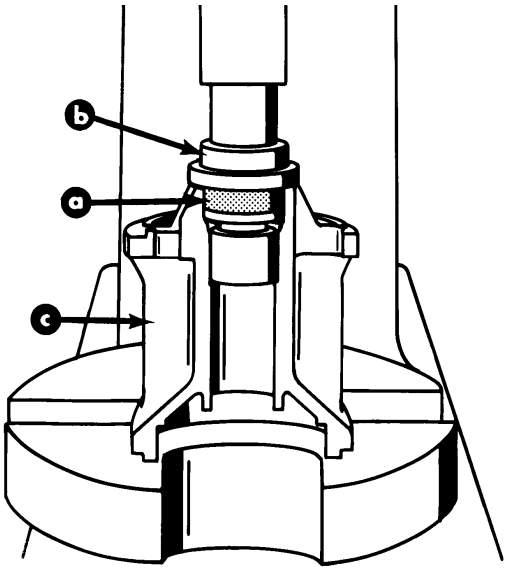
2. Apply Loctite 27131 or Type “A” to outside diameter of first propeller shaft oil seal. Install seal with lip facing needle bearing. Press oil seal with tool until tool bottoms on bearing carrier.



50315

a - Oil Seal
b - Oil Seal Driver (91-31108)
c - Bearing Carrier

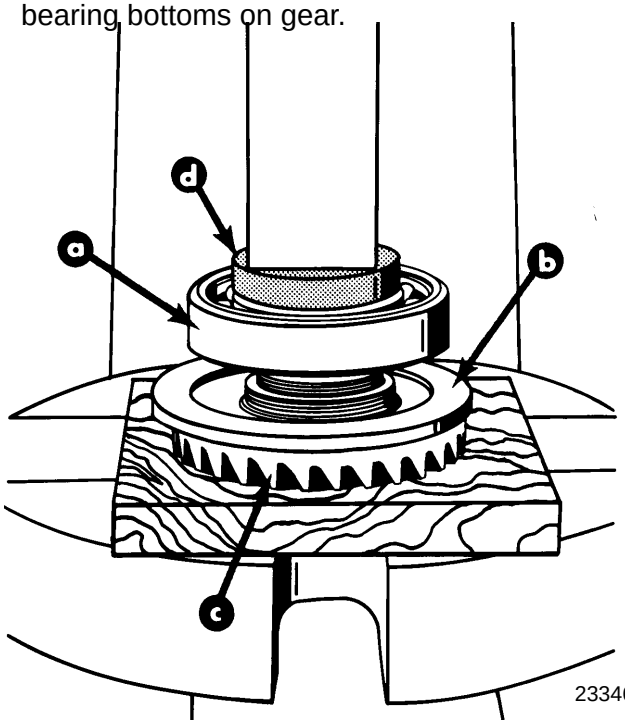
3. Apply Loctite 27131 or Type “A” to outside diameter of second propeller shaft oil seal. Install seal with lip facing away from needle bearing. Press oil seal with tool until tool bottoms on bearing carrier.



50315

a - Oil Seal
b - Oil Seal Driver (91-31108)
c - Bearing Carrier

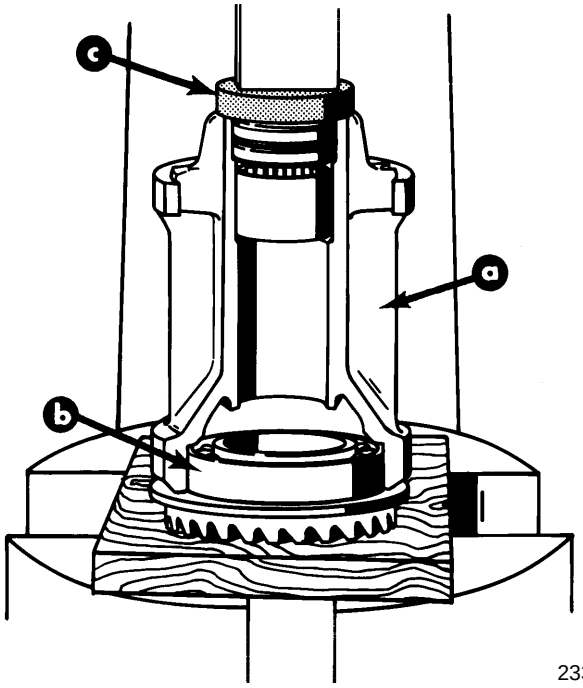
4. Install thrust washer and ball bearing on reverse gear. Press ball bearing using pilot washer until bearing bottoms on gear.



23346

a - Ball Bearing
b - Thrust Washer
c - Reverse Gear
d - Pilot Washer (91-36571)

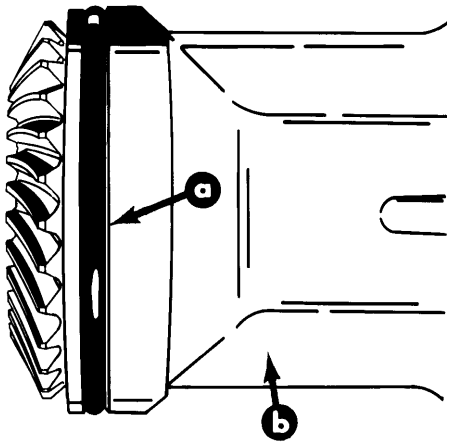
5. Press bearing carrier onto reverse gear and bearing until bearing bottoms in bearing carrier, using pilot washer to press against carrier.



23349

a - Bearing Carrier
b - Reverse Gear And Bearing Assembly
c - Pilot Washer (P/N 91-36571)

6. Install O-ring on bearing carrier.

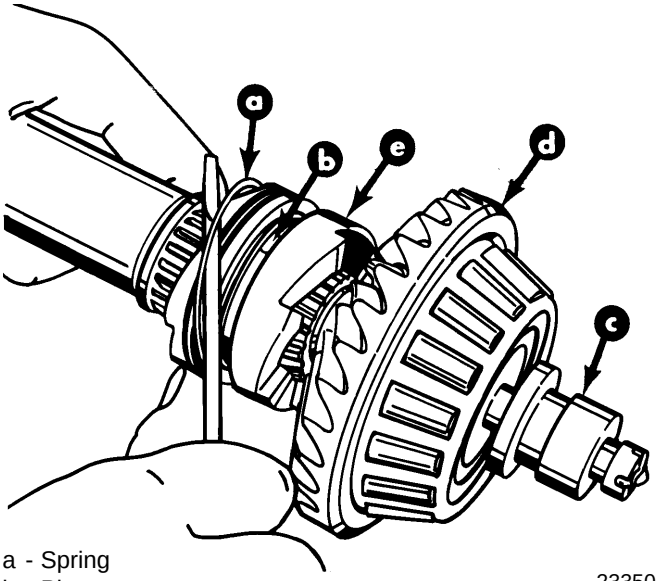


23354

a - O-ring
b - Bearing Carrier

PROPELLER SHAFT, FORWARD GEAR AND SHIFT SPOOL DISASSEMBLY

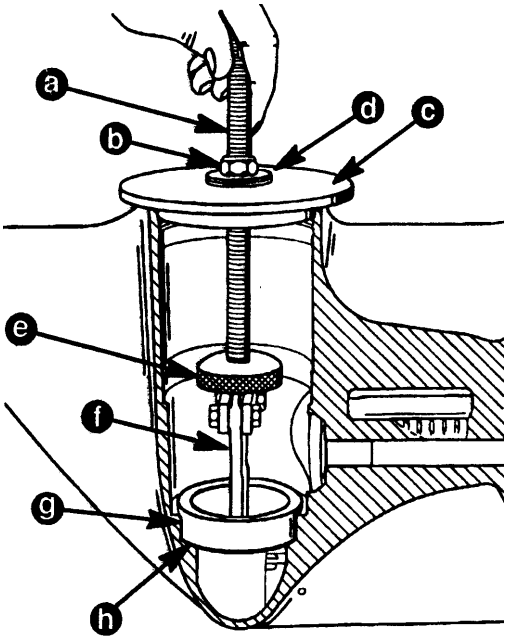
1. Remove components as shown.



23350

a - Spring
b - Pin
c - Shift Spool Assembly
d - Forward Gear Assembly
e - Sliding Clutch

2. Remove forward gear bearing cup and shims. Measure thickness then discard shims.



74008

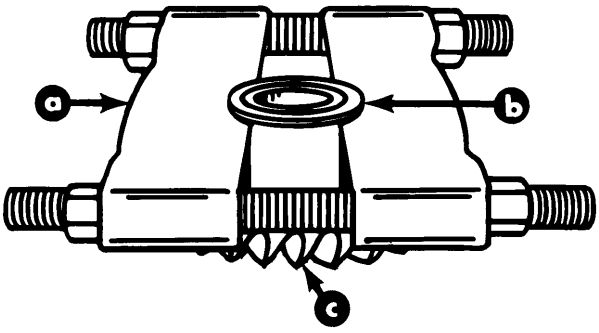
a - Puller Shaft (91-31229)
b - Nut (11-24156)
c - Guide Plate (91-816243)
d - Washer (91-34961)
e - Puller Head (From Slide Hammer Puller 91-34569a1)
f - Jaws (From Slide Hammer Puller 91-34569a1)
g - Bearing Adaptor
h - Shims

NOTE: *The condition of the forward gear tapered roller bearing cup is an indication of the condition of the tapered roller bearing. Replace bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.*

3. Remove tapered roller bearing from forward gear as follows:
   a. Cut off roller bearing cage; remove rollers.

NOTE: *It may be necessary to grind a groove at top lip of bearing race to securely hold universal puller plate in position.*

   b. Press gear from bearing race, using a suitable mandrel.

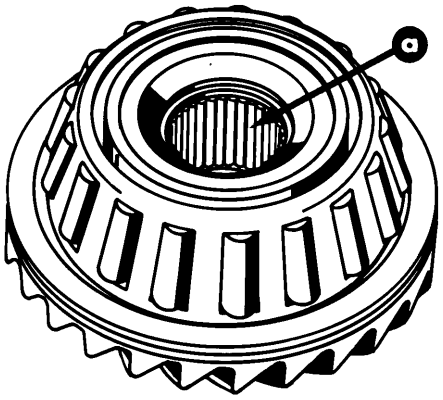


23141

a - Universal Puller Plate (91-37241)
b - Inner Bearing Race
c - Forward Gear

NOTE: *Forward gear needle bearing case is made of a very high tensile steel. Removal of bearing by conventional methods (e.g.-chisel and hammer or mandrel and press) may be very difficult. A notch in the casing may be made with the use of a high speed grinder.*

4. Remove forward gear needle bearing.

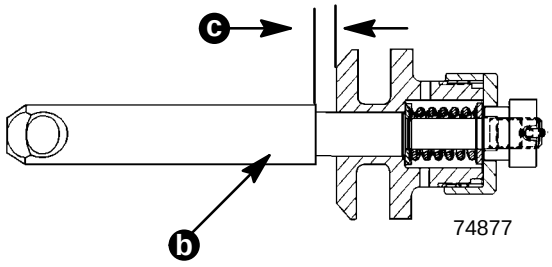


23352

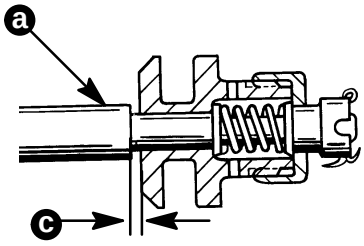
a - Forward Gear Needle Bearing

SHIFT SPOOL ASSEMBLY INSPECTION

NOTE: *The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool is sold as a whole assembly and can be used when replacing the earlier style (Prior to S/N OK041000). The end play for the spool will remain the same as the earlier models (.002-.010 in. .051-.254 mm).*



74877



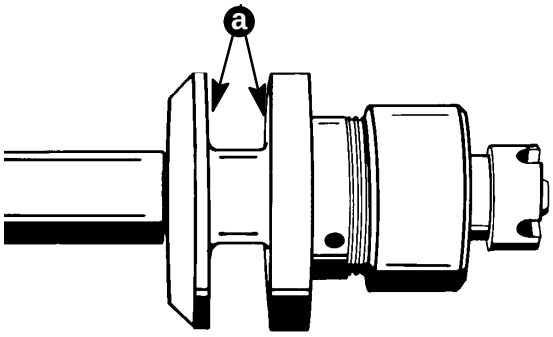
75219

a - Earlier Style Shift Spool Assembly
b - Later Style Shift Spool Assembly
c - Measure End Play Here At Gap

1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.

2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.

3. Inspect the shift spool for wear in the area where the shift crank comes into contact.

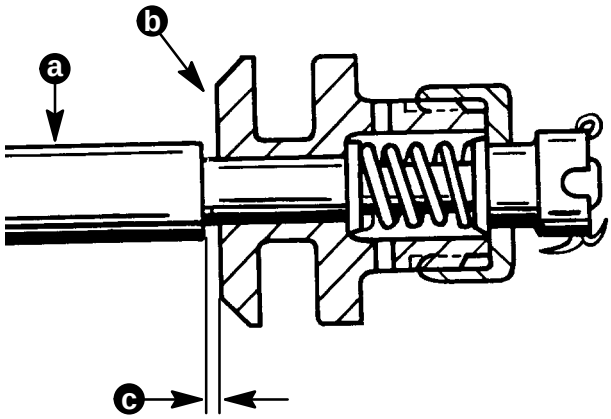


23356

a - Contact Area

4. Ensure that the spool spins freely. It may be helpful to lightly tap the castle nut end of the shift shaft against a firm surface to align the internal parts.

5. Remove the cotter pin and hand tighten end cap until it stops. At this point the shift spool will not turn freely on the shift shaft. Ensure that the spool has .002-.010 in. (.051-.254 mm) end play.

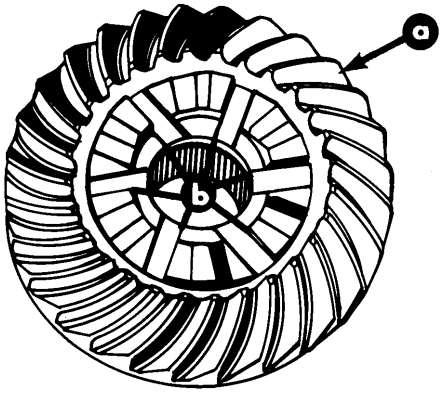


74877

a - Shift Shaft
b - Spool
c - Gap Has Increased-End Play Measurement: .002-.010 in. (0.05-0.2 5mm) Is Same As Earlier Models

PROPELLER SHAFT, FORWARD GEAR AND BEARING AND SHIFT SPOOL ASSEMBLY INSPECTION AND CLEANING

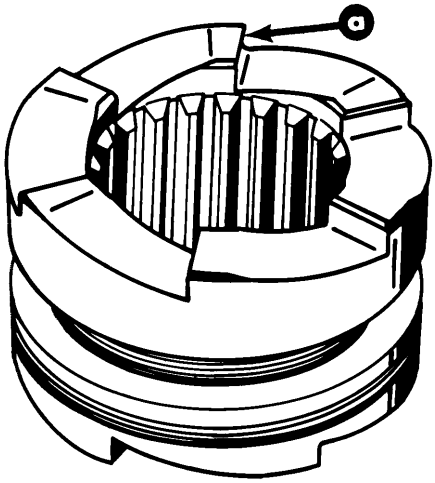
1. Inspect forward gear for pitting, chipped or broken teeth, fracturing and excessive or uneven wear.
2. Check forward gear clutch jaws for damage. Jaws must not be chipped or rounded off.



23351

a - Forward Gear Teeth
b - Clutch Jaws

3. Check sliding clutch engaging jaws for damage. Jaws must not be chipped or rounded off.



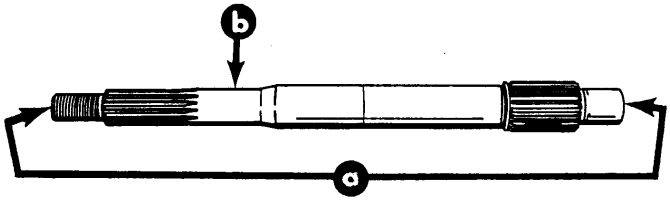
23350

a - Sliding Clutch Engaging Jaws

4. Check propeller shaft for bent condition. Use either method following:

LATHE AND DIAL INDICATOR

a. Position propeller shaft centers in lathe.
b. Mount dial indicator just forward of propeller shaft splines.
c. Rotate shaft and observe dial indicator movement. Movement of more than .005 in. (0.013 mm) is reason for replacement.



23355

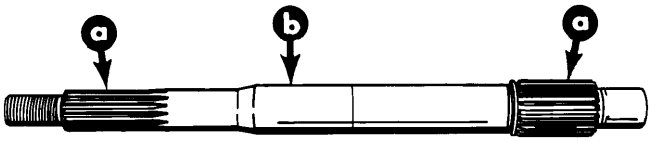
a - Propeller Shaft Centers
b - Mount Dial Indicator Here

V-BLOCKS AND DIAL INDICATOR

NOTE: *Be sure to adjust V-blocks to compensate for propeller shaft bearing surface diameters.*

a. Position propeller shaft bearing surfaces on V-blocks.
b. Mount dial indicator just forward of propeller shaft splines.
c. Rotate shaft and observe dial indicator movement. Movement of more than .005 in. (0.013 mm) is reason for replacement.

5. Inspect propeller shaft for broken or twisted splines.
6. Inspect surface of propeller shaft where bearing carrier oil seal lips contact shaft. If oil seals have made grooves, propeller shaft must be replaced.



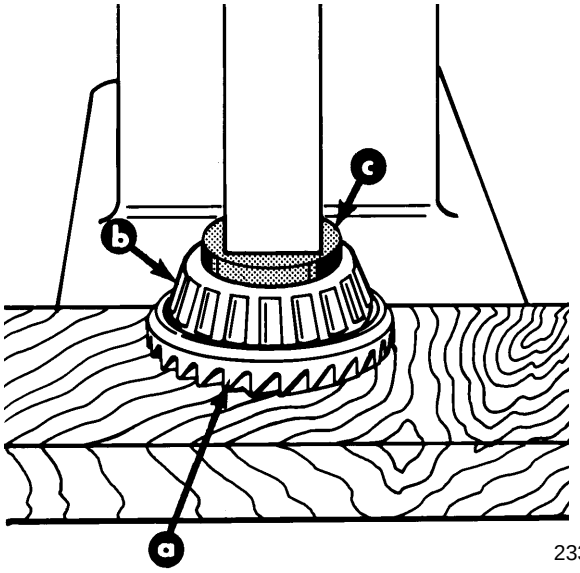
23355

a - Propeller Shaft Splines
b - Oil Seal Contact Area

7. Clean all component parts (except new bearings) with cleaning solvent. Dry components thoroughly with compressed air, being careful not to spin bearings.

PROPELLER SHAFT, FORWARD GEAR AND SHIFT SPOOL REASSEMBLY

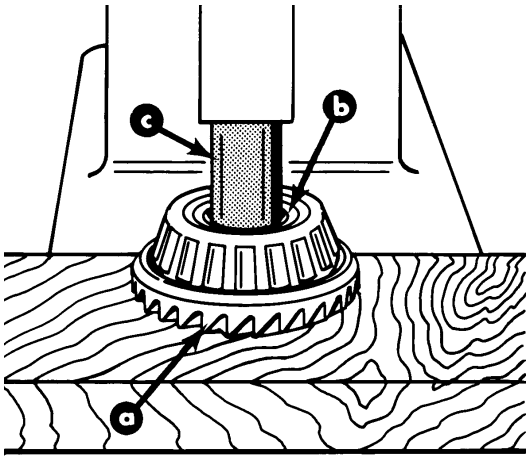
1. Using a suitable mandrel, press tapered roller bearing onto forward gear by pressing on inner bearing race until bearing bottoms on gear.



23353

a - Forward Gear
b - Tapered Roller Bearing
c - Suitable Mandrel

2. Using needle bearing driver, press needle bearing, with lettered side facing away from gear teeth, into forward gear until bearing bottoms inside gear.



a - Forward Gear
b - Needle Bearing (Not Seen)
c - Needle Bearing Driver (91-33491)

3. Assemble propeller shaft, forward gear and shift assembly as follows:

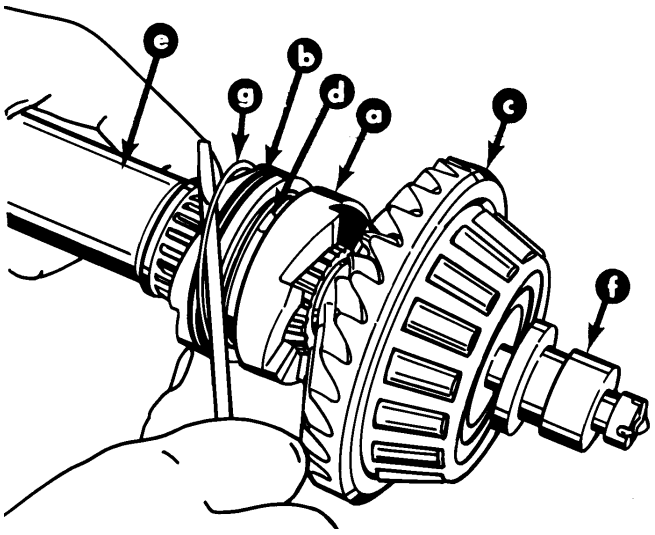
   a. Install sliding clutch on propeller shaft, being sure to align cross pin holes in clutch with slot in propeller shaft. Make sure sliding clutch is placed on propeller shaft with grooved end of clutch facing propeller end of shaft.

   b. Install forward gear and bearing assembly.

   c. Install spool and actuating shaft assembly.

   d. Install cross pin through sliding clutch, propeller shaft and actuating shaft.

   e. Being careful not to distort cross pin retainer spring, install spring to cover cross pin hole.

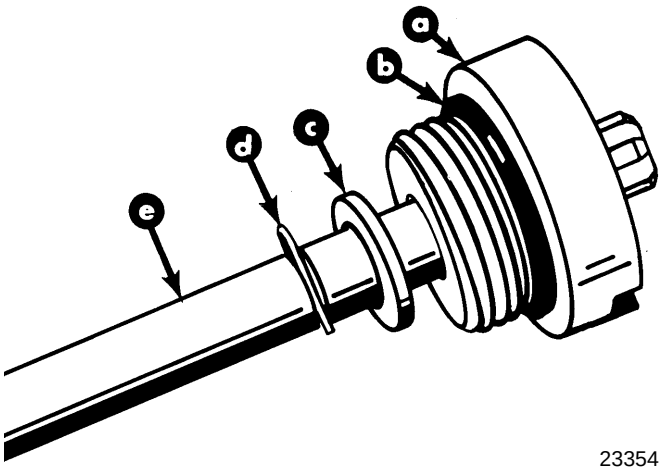


23350

a - Sliding Clutch
b - Grooves In Clutch
c - Forward Gear Assembly
d - Cross Pin
e - Propeller Shaft
f - Spool And Actuating Shaft Assembly
g - Cross Pin Retainer Spring

SHIFT SHAFT DISASSEMBLY

1. Remove shift shaft components as shown.

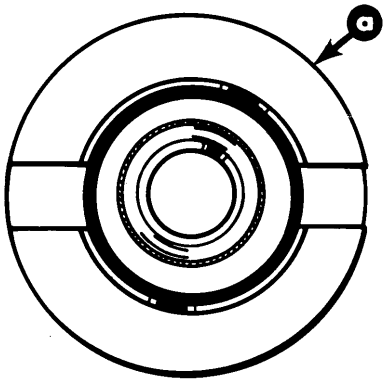


23354

a - Shift Shaft Bushing
b - O-ring
c - Washer
d - Clip
e - Shift Shaft

SHIFT SHAFT INSPECTION AND CLEANING

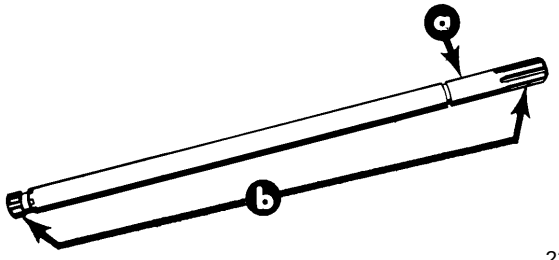
1. Inspect shift shaft bushing for corrosion.



23349

a - Shift Shaft Bushing

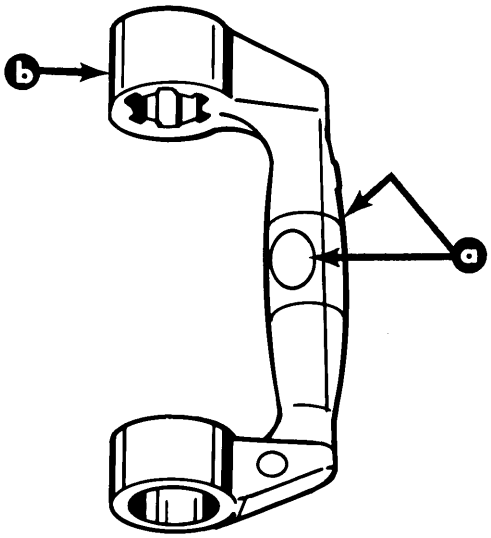
2. Inspect shift shaft splines and seal surface for corrosion. Ensure splines are not twisted.



23355

a - Seal Surface
b - Splines

3. Inspect shift crank for wear in area that contacts shift spool.



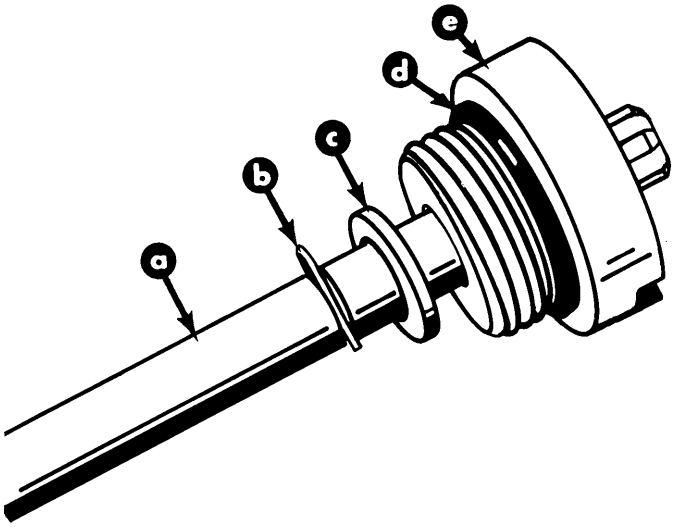
23350

a - Contact Area
b - Shift Crank

SHIFT SHAFT REASSEMBLY

NOTE: *If oil seal in shift shaft bushing is found to be defective, oil seal and shift shaft bushing must be replaced as an assembly.*

1. Reassemble shift shaft components in order shown.



23354

a - Shift Shaft
b - Clip
c - Washer
d - O-ring
e - Shift Shaft Bushing (Seal Inside)

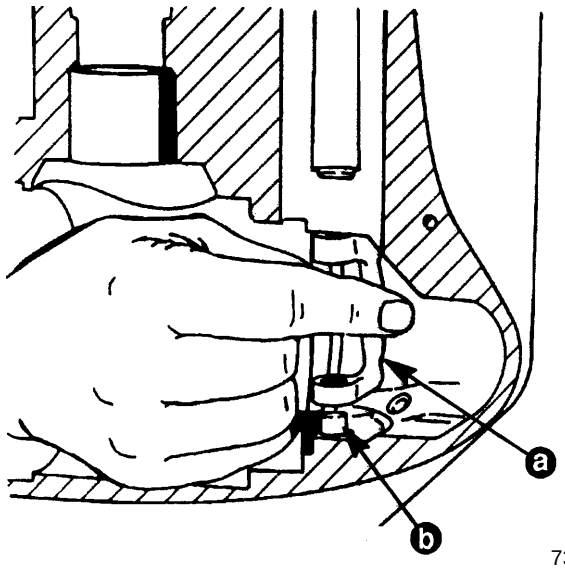
GEAR HOUSING CLEANING AND INSPECTION

1. Check gear housing carefully for impact damage.
2. Inspect bearing carrier retainer threads, in gear housing for corrosion or stripped threads. Clean with hard bristle brush.
3. Inspect bearing contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores.
4. Inspect for blockage in water inlet holes. Clean if necessary.
5. Make sure that locating pins are in place in gear housing and that corresponding holes in drive shaft housing are not elongated. Drive shaft may break if housings are not aligned properly.

Gear Housing Reassembly And Shimming

SHIFT SHAFT INSTALLATION

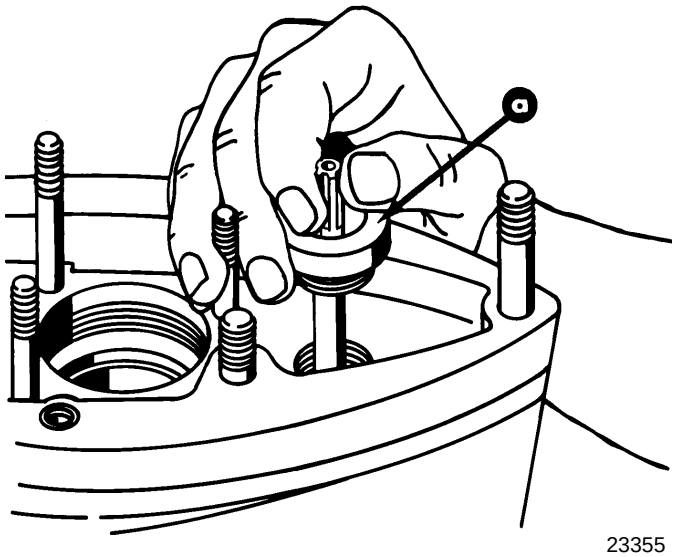
1. Place shift crank on locating pin in forward section of gear housing. Ensure shift crank faces toward left (port) side of gear housing.



73870

a - Shift Crank
b - Locating Pin

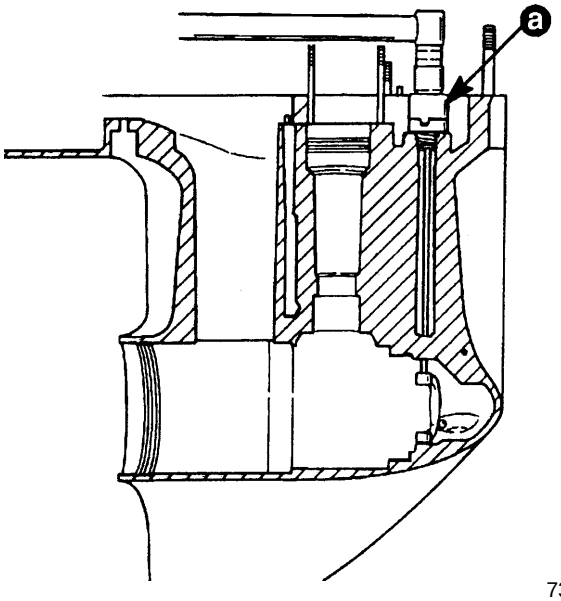
2. Install shift shaft assembly into gear housing as shown. Ensure that lower splined end of shift shaft is engaged with shift crank.



23355

a - Shift Shaft Assembly

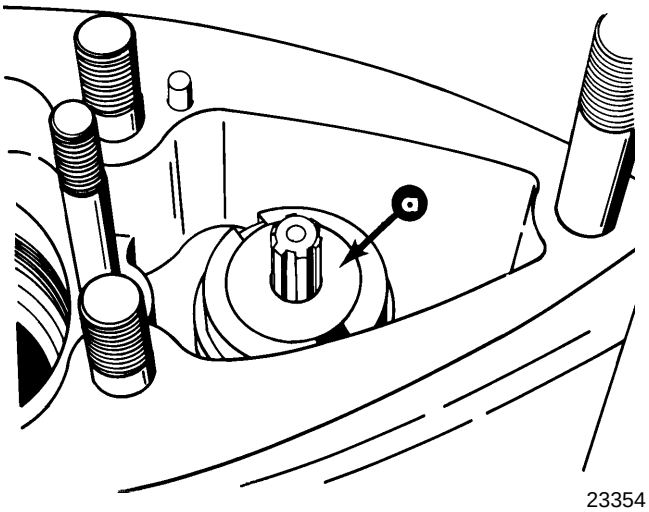
3. Thread shift shaft bushing into gear housing. Torque to 50 lb. ft. (68 N·m) using shift shaft bushing tool.



73883

a - Shift Shaft Bushing Tool (91-31107)

4. Install rubber washer and then stainless steel washer onto shift shaft.

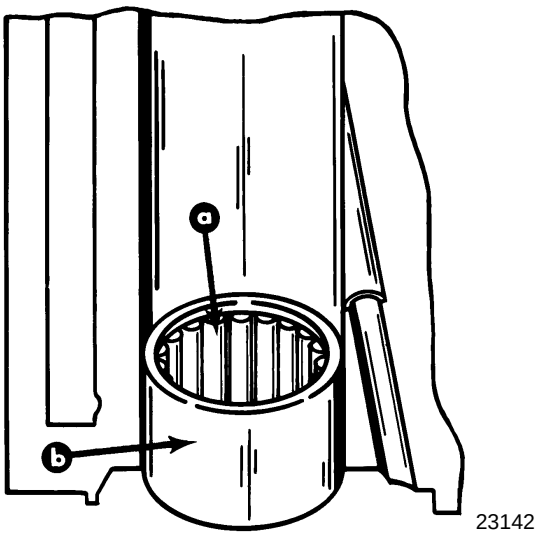


a - Stainless Steel Washer (Rubber Washer Beneath)

DRIVE SHAFT AND PINION GEAR INSTALLATION (WITHOUT PROPELLER SHAFT IN PLACE)

IMPORTANT: If unit does not require reshimming (no parts were replaced), proceed to Propeller Shaft and Forward Gear Installation. If pinion height must be checked, proceed as follows.

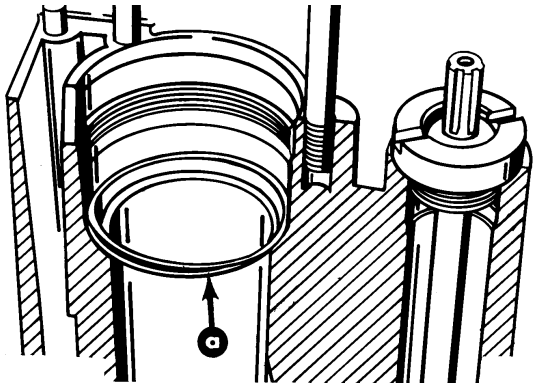
1. If pinion bearing was not replaced, but needle bearings have fallen out during disassembly, install 18 needles in needle bearing outer race. Use needle bearing assembly lubricant to help hold needles in place.



a - Rollers (18)
b - Roller Bearing Outer Race

NOTE: *If shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing or gear housing were replaced, start off by installing a .015 in. (0.38 mm) shim.*

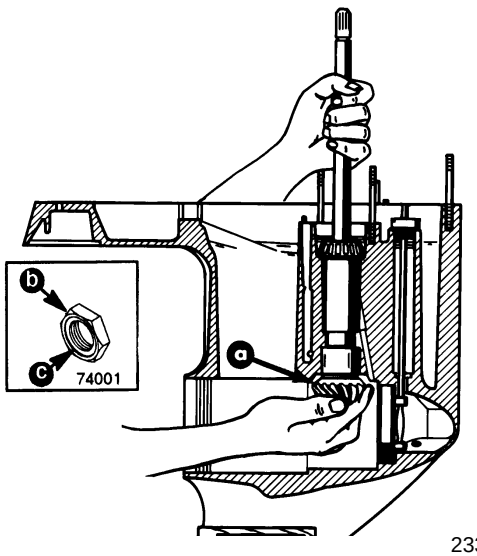
2. Place shim(s) in drive shaft, housing bore.



a - Shim(s)

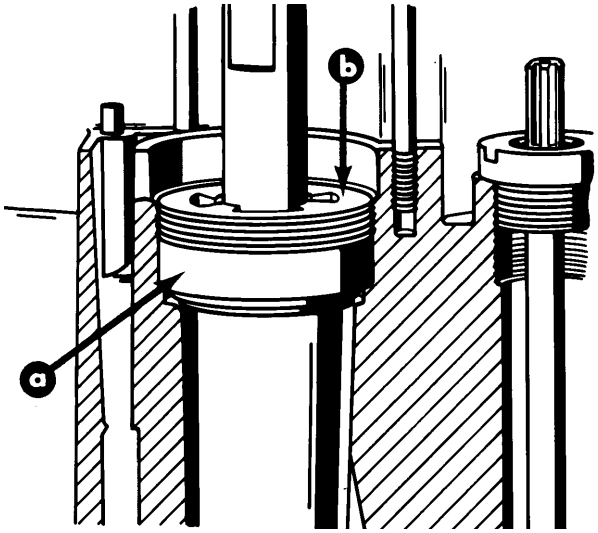
NOTE: *For ease of installation, glue washer to pinion gear, using 3M Adhesive (92-86166-1) or equivalent.*

3. Install drive shaft and pinion gear as follows:
   a. Place pinion gear and washer in gear housing.
   b. Insert drive shaft into gear housing bore. Rotate drive shaft to engage drive shaft splines with pinion gear splines.
   c. Hand thread nut onto drive shaft. DO NOT tighten further at this time. if the pinion gear nut has a machined shoulder on one side, install the shouldered side against the pinion gear. If both sides of the nut are shouldered, then either side of the nut may rest against the pinion gear.



a - Pinion Gear, Nut And Washer
b - Pinion Nut
c - Shoulder

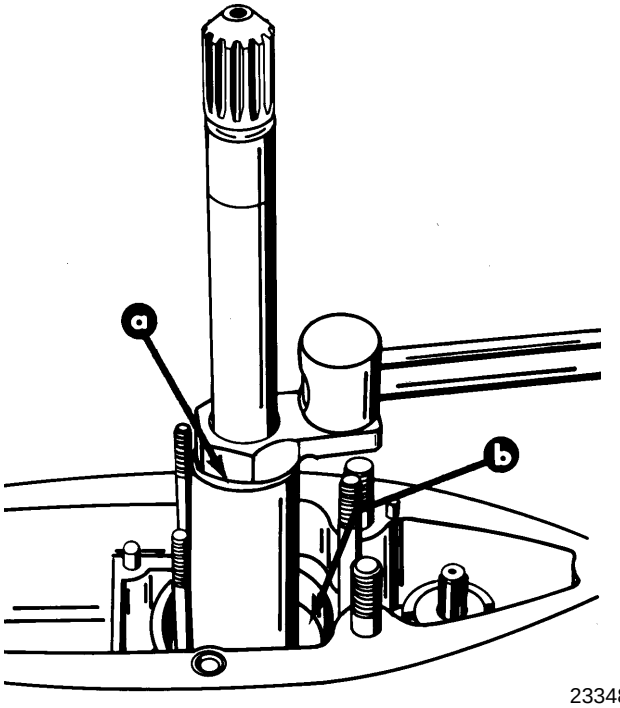
4. Install bearing cup and retainer.



23352

a - Bearing Cup
b - Retainer

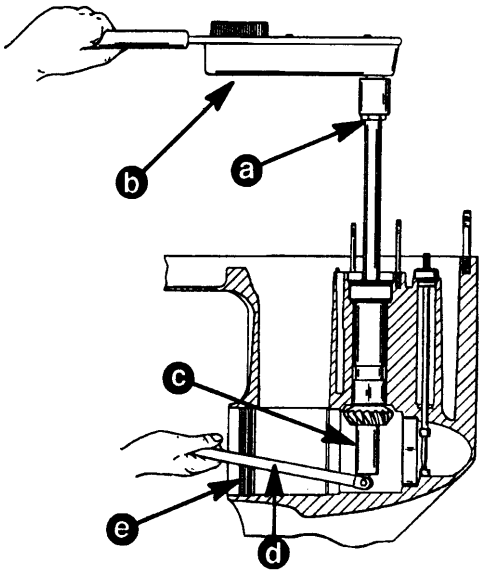
5. Torque retainer using Drive Shaft Bearing Retainer Tool (91-43506) to 100 lb. ft. (130 N·m).



23348

a - Drive Shaft Bearing Retainer Tool (91-43506)
b - Retainer

6. Partially install bearing carrier retainer nut (to protect threads) and torque pinion nut to 60-80 lb. ft. (81-108 N·m).

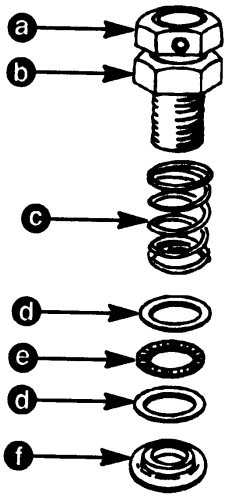


73884

a - Drive Shaft Nut Wrench (91-56775)
b - Torque Wrench
c - Socket
d - Breaker Bar
e - Bearing Carrier Retainer

CHECKING PINION GEAR HEIGHT

1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.

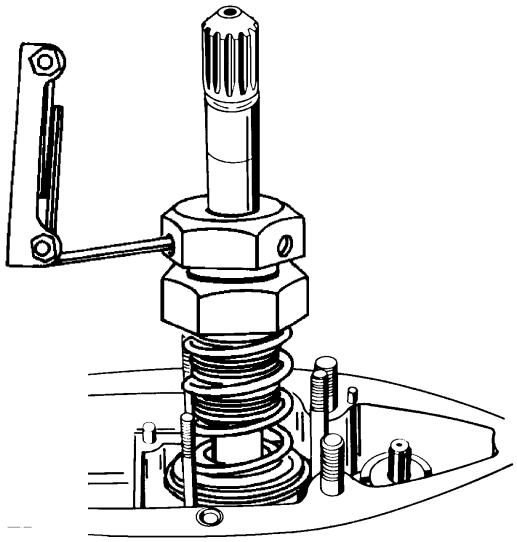


73885

Current Style Preload Tool Installation

a - Top Nut With Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer

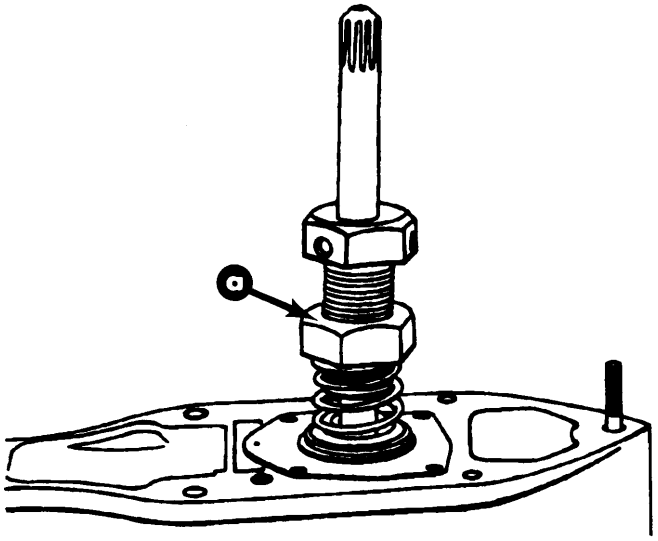
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



75733

a - Allen Screws

3. Screw the bottom nut of the bearing preload tool down until it is one inch further down the threaded rod than it was previously.

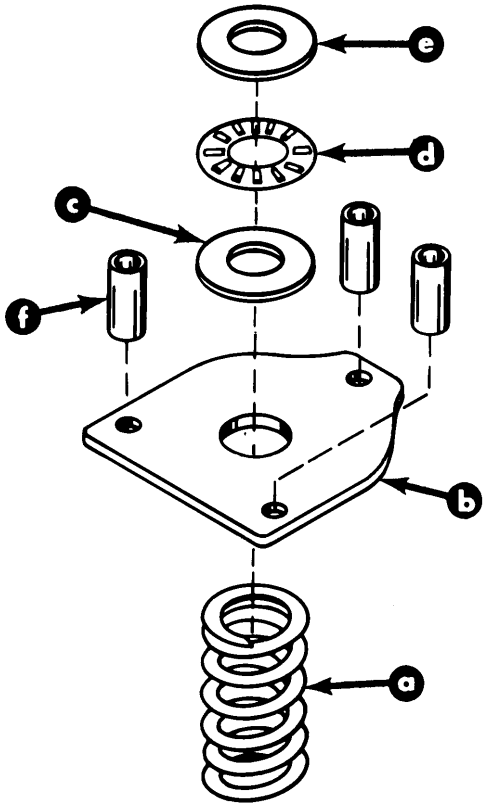


71591

a - Bottom Nut

4. Rotate the drive shaft at least three full turns in a clockwise direction.

1. Install the components from Bearing Preload Tool (91-44307A1) over drive shaft in order shown.

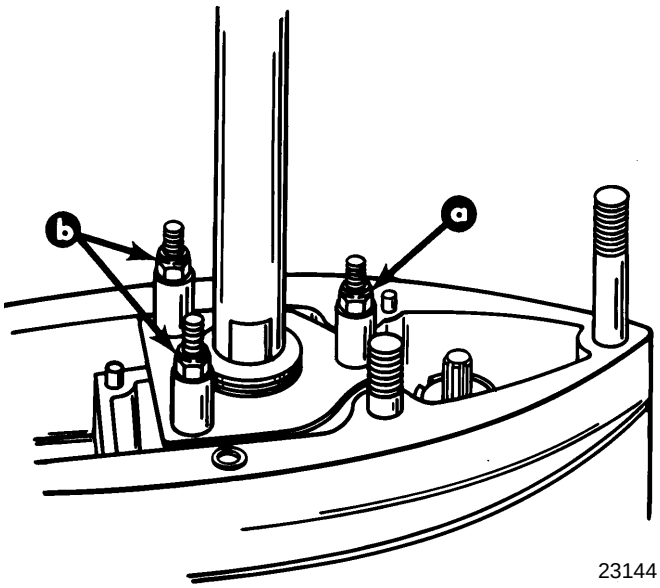


23144

Early Style Preload Tool Installation

a - Spring
b - Plate
c - Washer
d - Bearing
e - Washer
f - Spacers (3)

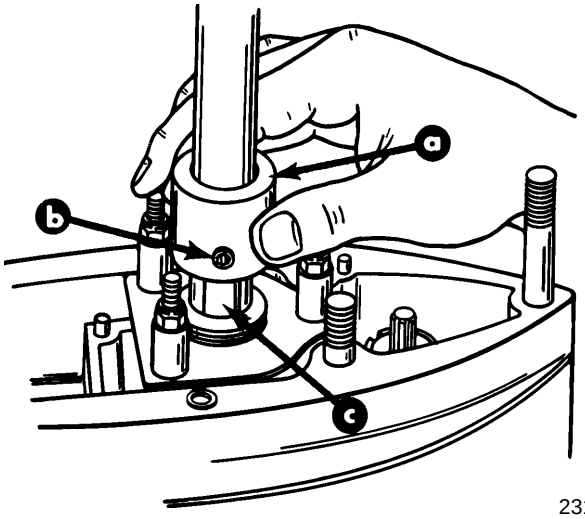
2. Install and tighten nuts until they just bottom on spacers.



23144

a - Nuts

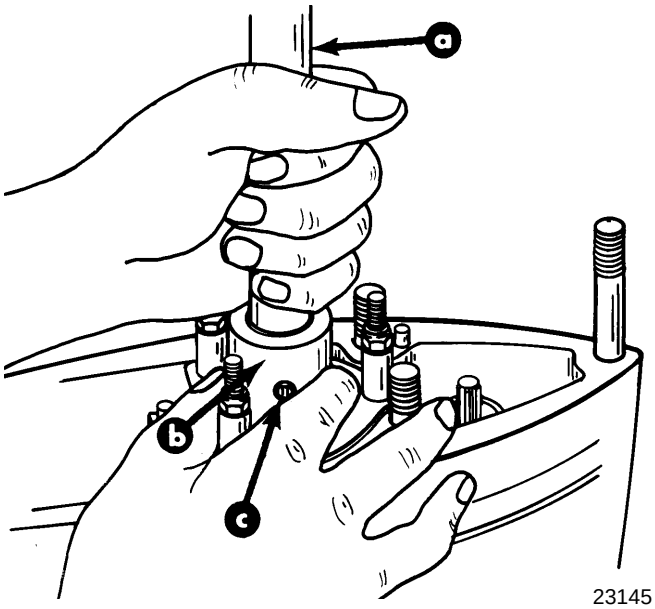
3. Place collar from Bearing Preload Tool (P/N 91-44307A1) over drive shaft with set screw down. Align set screw with flat on drive shaft.



23145

a - Collar
b - Set Screw
c - Flat On Drive Shaft

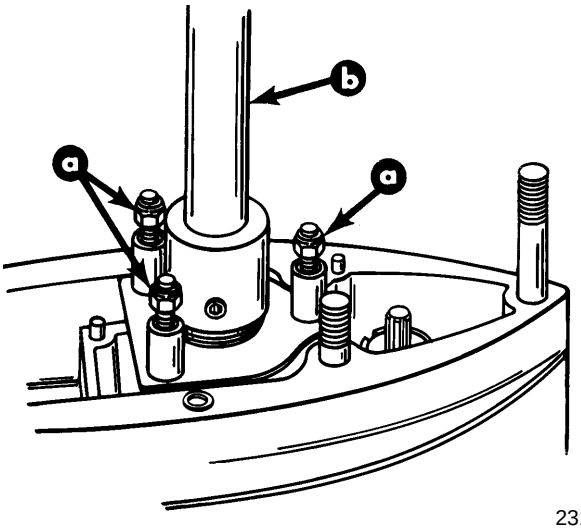
4. Pull up on drive shaft, push down on collar and tighten set screw.



23145

a - Drive Shaft
b - Collar
c - Set Screw

5. Back off nuts 3-4 turns and then rotate drive shaft clockwise 2 or more turns to seat bearings.



23146

a - Nuts
b - Drive Shaft

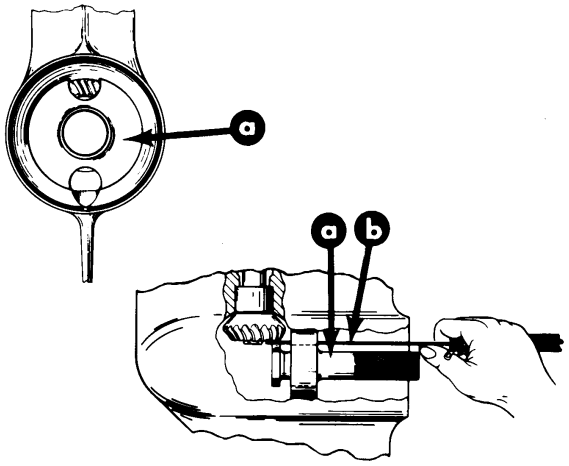
6. Measure pinion height as follows:

   a. Place pinion gear shimming tool in gear housing.

NOTE: *Take the following measurements at 3 locations, rotating drive shaft and pinion gear 120 degrees at a time.*

   b. Insert a .025 in. (0.64 mm) feeler gauge between one tooth of pinion gear and high point of shimming tool. Take 2 or more readings, rotating drive shaft and pinion gear 120 degrees at a time. Clearance should be exactly .025 in. (0.64 mm).

   c. If clearance is not correct, add or subtract shims from beneath drive shaft tapered roller bearing cup to obtain proper pinion gear height.



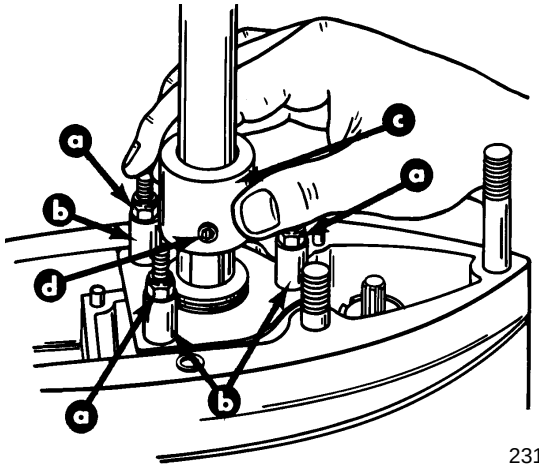
26410

a - Pinion Gear Shimming Tool (91-56048)
b - .025 in. (0.64 mm) Feeler Gauge

⚠CAUTION

Before loosening collar set screw, tighten bearing preload tool nuts until they bottom on spacers.

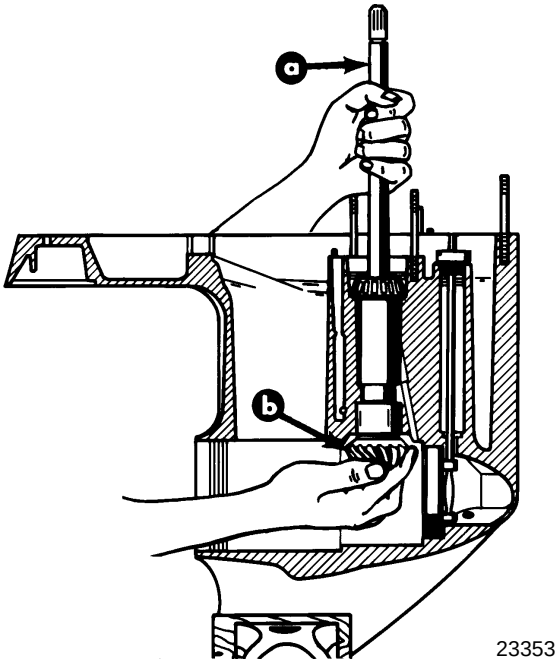
7. Remove bearing preload tool as follows:
   a. Tighten 3 nuts until they bottom on spacers.
   b. Loosen collar set screw and remove collar.
   c. Remove remaining bearing preload tool components.
   d. Remove drive shaft bearing retainer nut.



23145

a - Nuts (3)
b - Spacers
c - Collar
d - Set Screw

8. Install bearing carrier retainer nut (to protect threads), remove pinion nut, lift up on drive shaft and remove drive shaft and pinion gear.



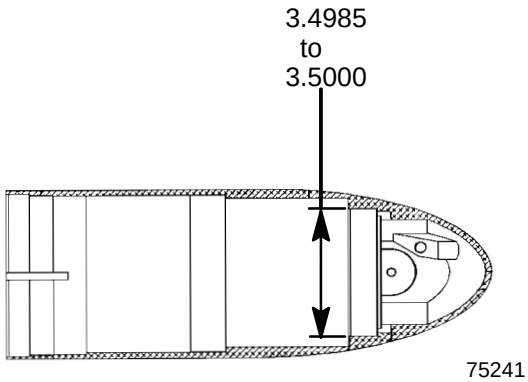
23353

a - Drive Shaft
b - Pinion Gear

FORWARD GEAR BEARING CUP INSTALLATION

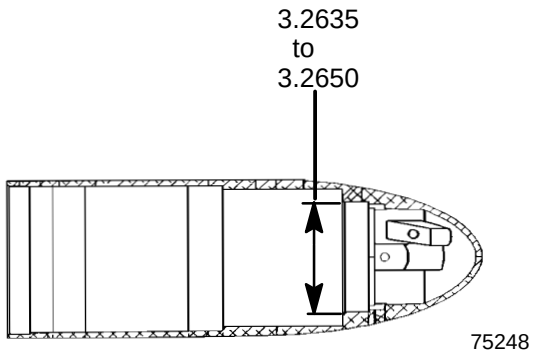
IMPORTANT: Before proceeding, refer to Special Information about replacement gear housings at the front of this section.

NOTE: *The later style forward gear bearing bore is smaller (3.2635 to 3.2650 in.) than the earlier style (3.4985 to 3.5000 in.) This slightly smaller bearing bore for the forward gear bearing adaptor is approximately 1/4 in. (6.3 mm) smaller.*



75241

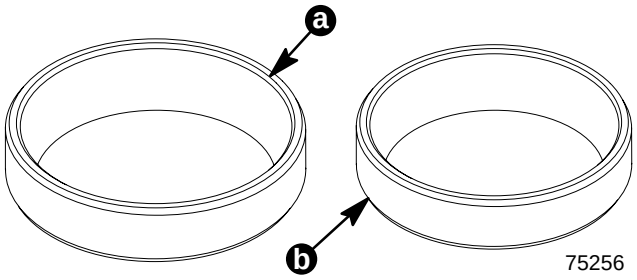
Earlier Style Forward Gear Bore



75248

Later Style Forward Gear Bore

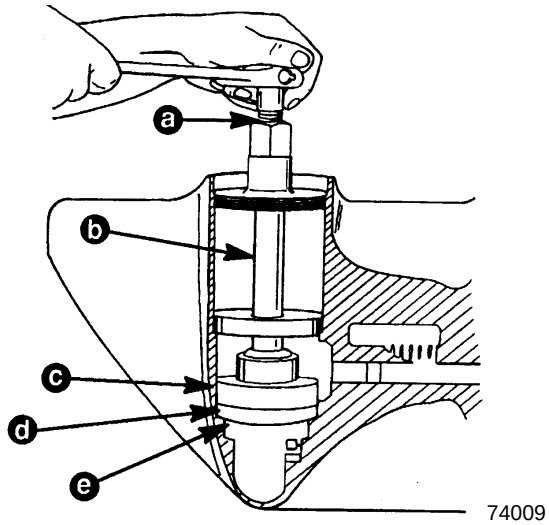
The later style bearing cup is thinner and has a smaller diameter than the earlier style.



a - Earlier Style Gear Bearing Cup 3.500 in. Diameter
b - Later Style Gear Bearing Cup 3.265 in. Diameter

NOTE: *If installing new shims, start with a .020 in. (0.050 mm) shim pack.*

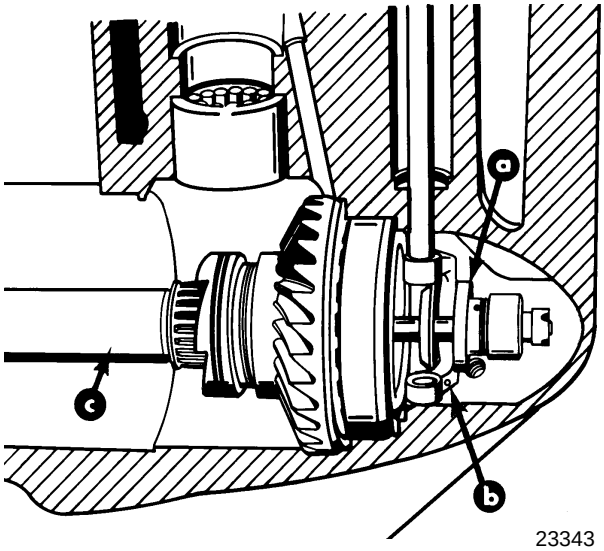
1. Place shims in gear housing.
2. Lubricate threads of hex head screw with Quicksilver Special Lubricant 101.
3. Install the bearing cup with the Bearing Adaptor Installation Tool (91-18605A1).



a - Hex-Head Screw
b - Bearing Adaptor Installation Tool (91-18605A1)
c - Cup Driver (Earlier 91-36577)
d - Bearing Cup
e - Shims

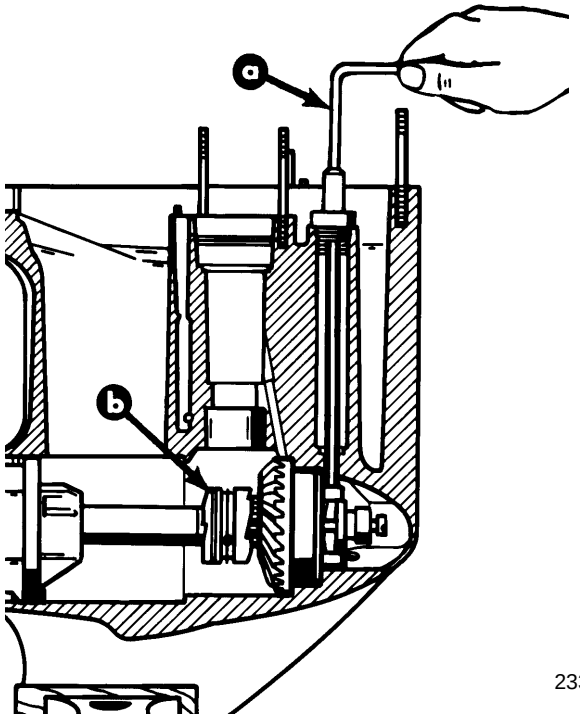
PROPELLER SHAFT, FORWARD GEAR AND SHIFT SPOOL INSTALLATION

1. To allow engagement of shift actuating spool with shift crank, install propeller shaft assembly by tilting propeller end of shaft to the left (port) side of gear housing.



a - Shift Actuating Spool
b - Shift Crank
c - Propeller Shaft Assembly

2. Reposition propeller shaft so that it is straight in bore.
3. Operate shift shaft to assure proper installation. Sliding clutch should move back and forth on propeller shaft as shift shaft is turned.



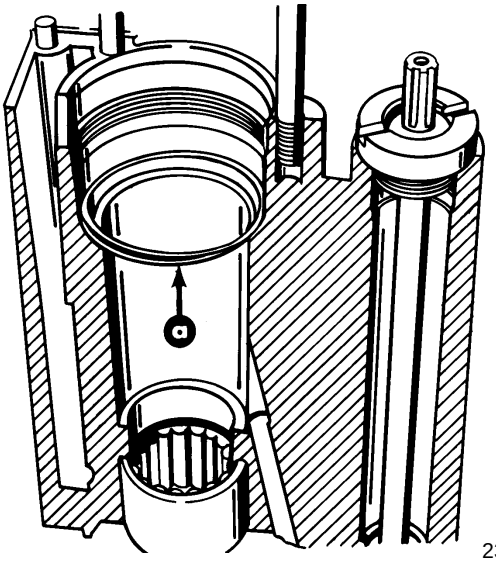
a - Shift Shaft Tool
b - Sliding Clutch

DRIVE SHAFT AND PINION GEAR INSTALLATION (WITH PROPELLER SHAFT IN PLACE)

NOTE: *On final installation, after all shimming has been checked, apply Loctite 27131 or Type "A" to threads of pinion nut.*

1. Install drive shaft as follows:

   a. Install original shims or shim thickness determined from checking pinion gear height, into drive shaft bore.



23351

a - Shims

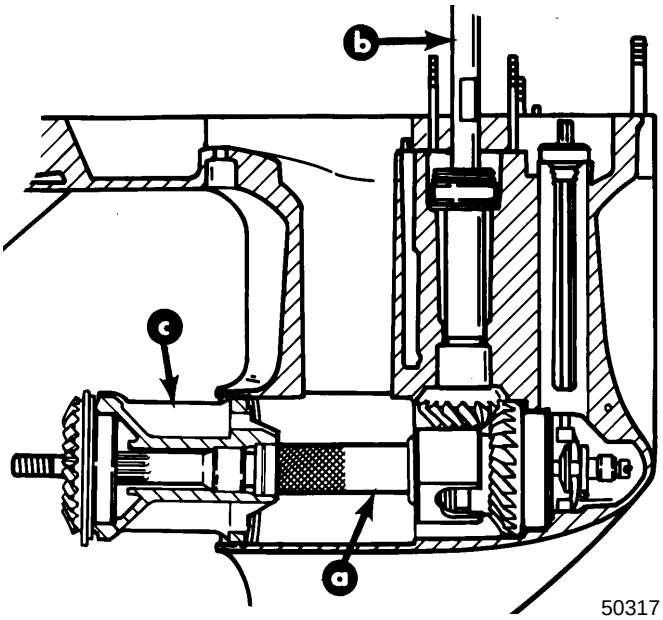
   b. Apply Loctite 27131 (92-809820) to pinion nut threads.

   c. Place pinion nut (with washer glued in place) on pinion nut adaptor. Install pinion nut with the machined shoulder against the pinion gear. If both sides of the nut have a machined shoulder, then either shoulder may be placed against the pinion gear.

   d. Install drive shaft and pinion gear. Rotate drive shaft to allow drive shaft splines and pinion gear splines to engage. DO NOT push pinion gear completely onto drive shaft until pinion nut adaptor (with nut and washer is in place in the following step).

   e. Insert pinion nut adaptor (with nut and washer) into gear housing, you might need to raise drive shaft to clear rod. Start pinion nut threads on drive shaft by rotating drive shaft.

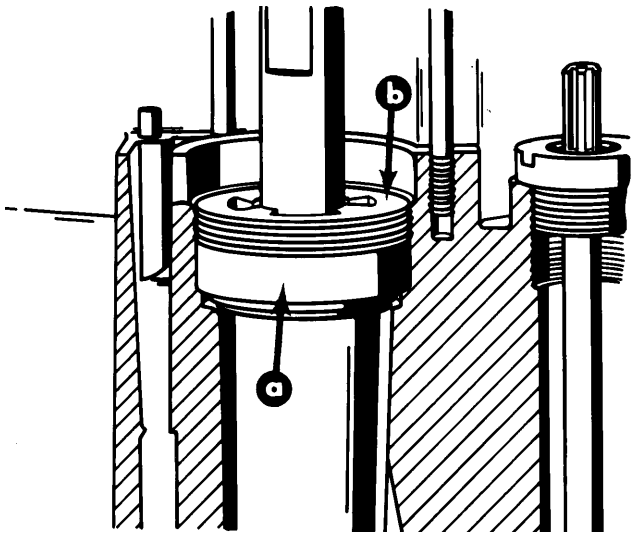
   f. Install bearing carrier into gear housing backwards to hold propeller shaft and pinion nut adaptor straight when tightening nut.



50317

a - Pinion Nut Adaptor (91-61067A3)
b - Drive Shaft
c - Bearing Carrier

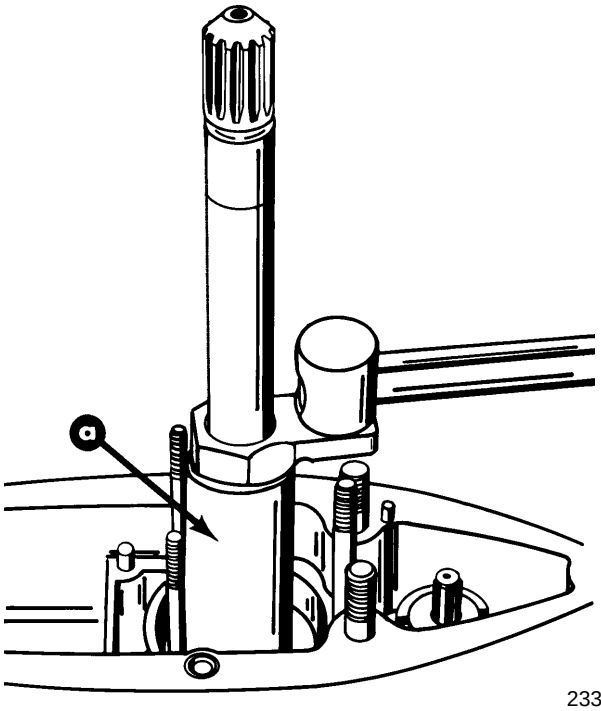
   g. Install drive shaft tapered roller bearing cup and retainer.



23352

a - Bearing Cup
b - Retainer

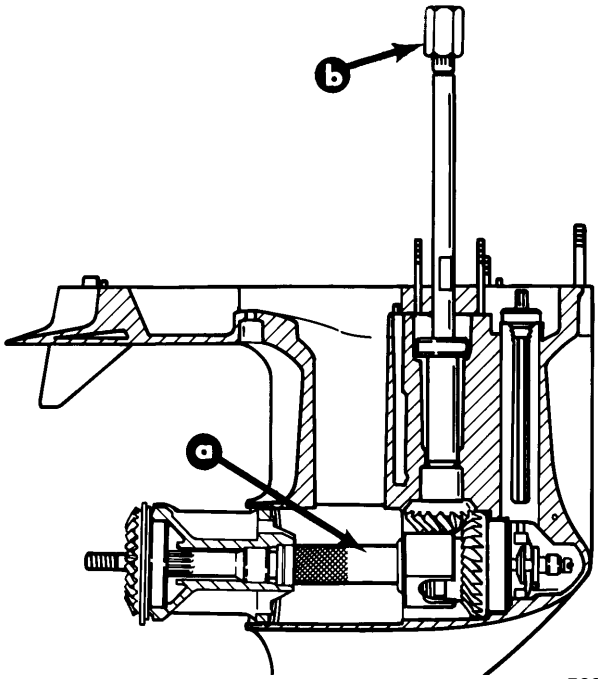
h. Torque retainer to 100 lb. ft. (130 N·m).



23343

a - Drive Shaft Bearing Retainer Tool (91-43506)

i. Torque pinion nut by turning drive shaft using pinion nut wrench and torque wrench with appropriate socket, to 60-80 lb. ft.(81-108 N·m).



50313

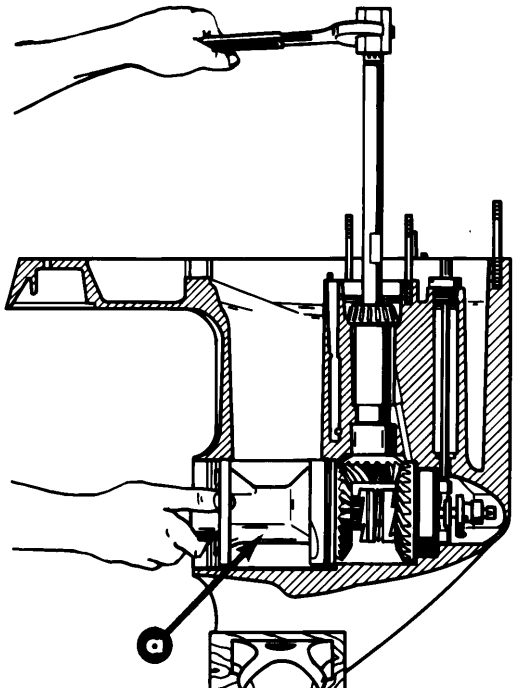
a - Pinion Nut Adaptor (91-61067A3)
b - Drive Shaft Nut Wrench (91-56775)

j. Remove bearing carrier, pinion nut adaptor and drive shaft nut wrench.

BEARING CARRIER AND REVERSE GEAR INSTALLATION

NOTE: *Perform STEP 1, when reassembling unit for the last time (after checking shimming).*

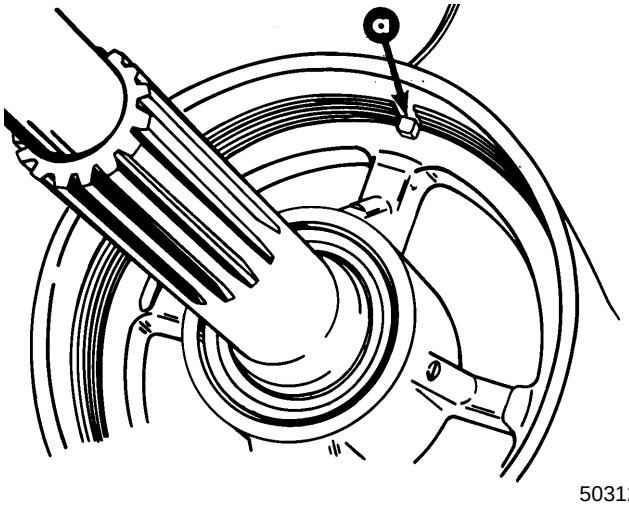
1. Lubricate the following as specified:
   a. Lubricate outer diameter of bearing carrier (including O-ring) with Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal.
   b. Fill space between carrier oil seals with 2-4-C Marine Lubricant.
   c. Lubricate bearing carrier retainer with Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal.
2. Place bearing carrier assembly into gear housing. It may be necessary to turn drive shaft to align teeth of pinion and reverse gears.



23346

a - Bearing Carrier Assembly

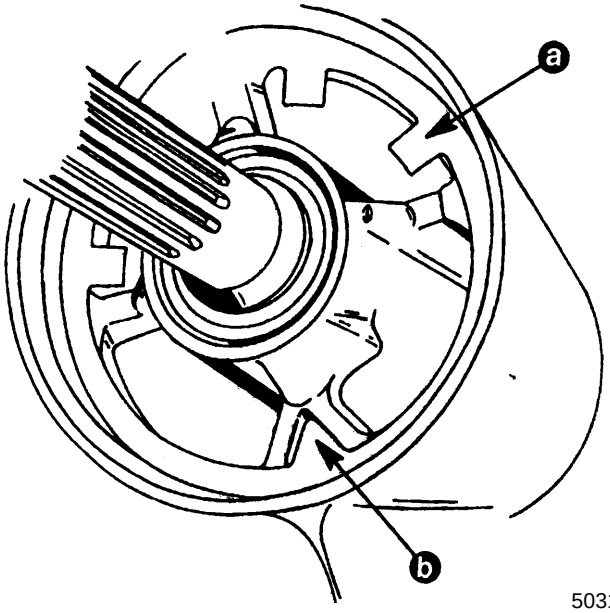
3. Align bearing carrier key slot and key slot in gear housing and install key.



50312

a - Key

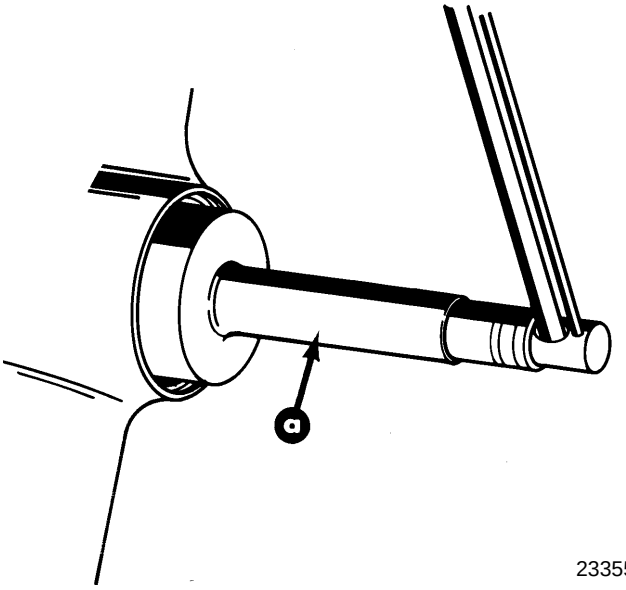
4. Install tab washer. Ensure “V” shaped tab aligns with “V” notch in bearing carrier.



50314

a - Tab Washer
b - “V” Tab

5. Install bearing carrier retainer. Torque to 210 lb. ft. (285 N·m). Make sure the tab washer tabs line up with the bearing carrier retainer.

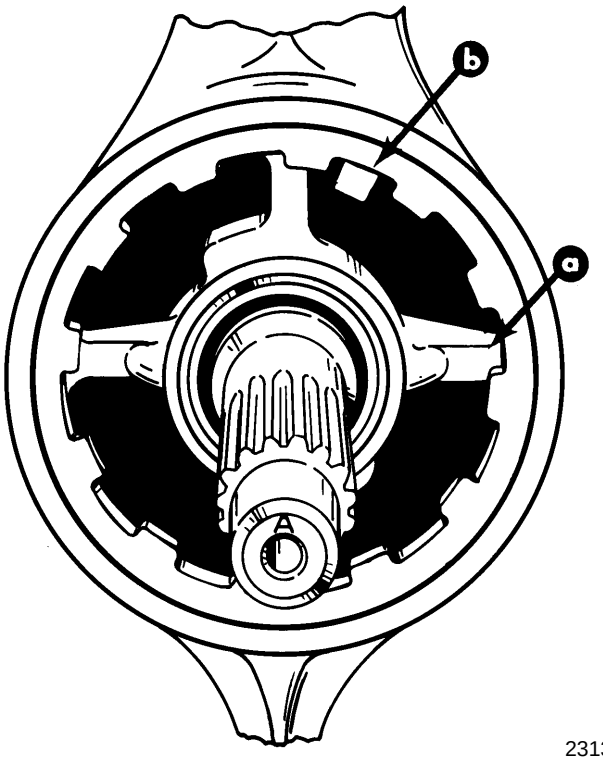


23355

a - Bearing Carrier Retainer Wrench (91-61069)

IMPORTANT: Do not secure bearing carrier retainer by bending tab on tab washer until forward and reverse gear backlash have been checked and corrected as explained following.

6. If backlash is correct, bend three tabs in toward bearing carrier and one tab out into a notch in bearing carrier retainer.



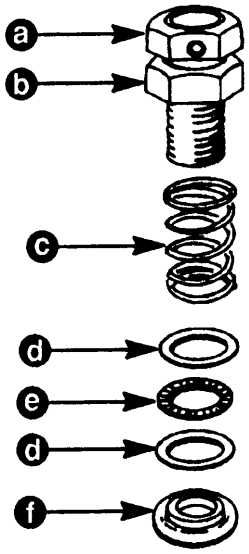
23137

a - Bearing Carrier
b - Tab Washer

CHECKING FORWARD GEAR BACKLASH

Current Style Preload Tool Installation

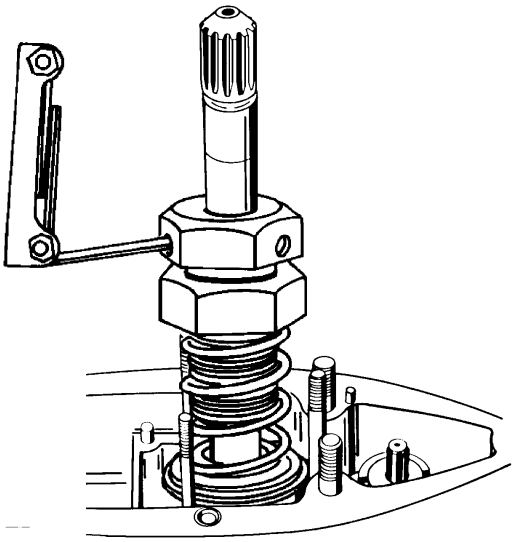
1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order show



73885

a - Top Nut With Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer

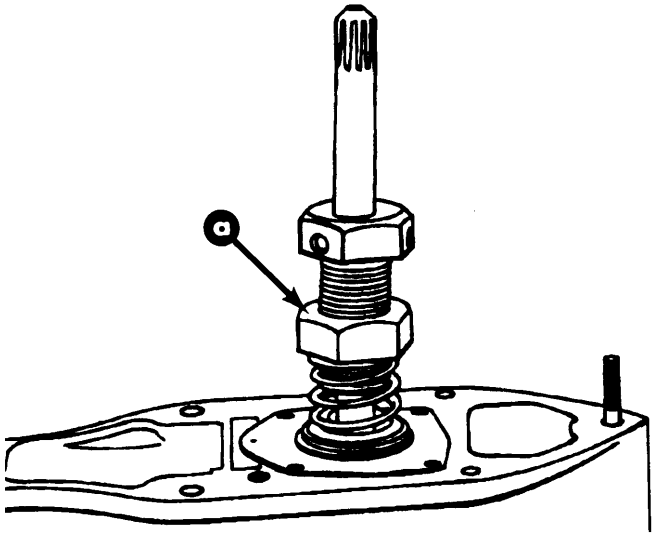
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



75733

a - Allen Screws

3. Screw the bottom nut of the bearing preload tool down until it is one inch further down the threaded rod than it was previously.



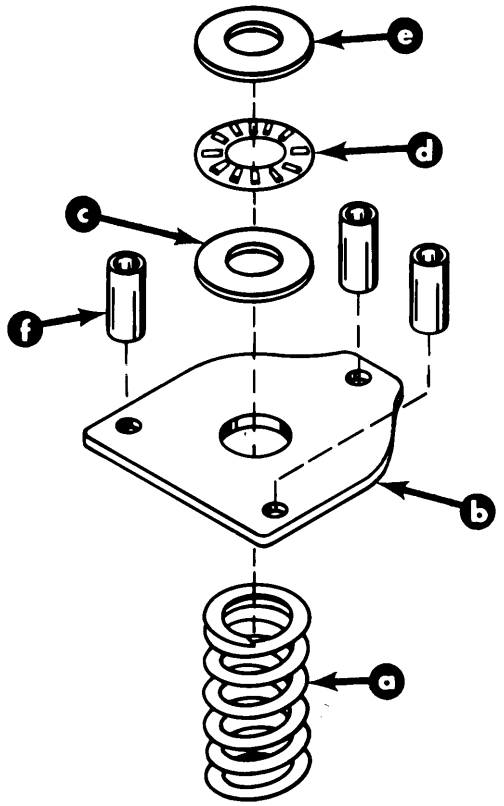
71591

a - Bottom Nut [Screwed Down Approximately 1 In. (25.4mm) Further Than It Was Previously]

4. Rotate the drive shaft at least three full turns in a clockwise direction.

Early Style Preload Tool Installation

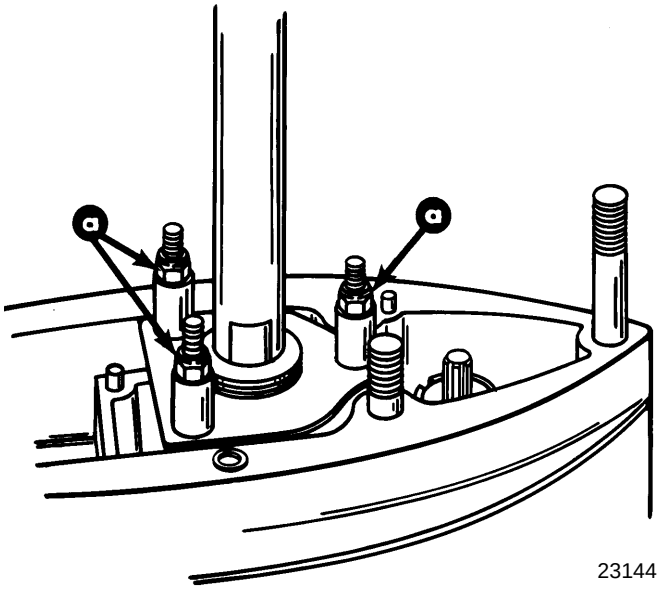
1. Install the following components from Bearing Preload Tool (91-44307A1) over driveshaft in order shown.



23144

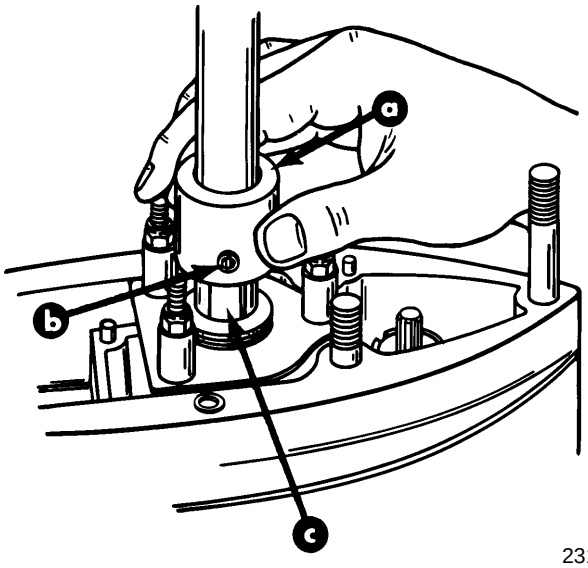
a - Spring
b - Plate
c - Washer
d - Bearing
e - Washer
f - Spacers (3)

2. Install and tighten nuts until they just bottom on spacers.



23144

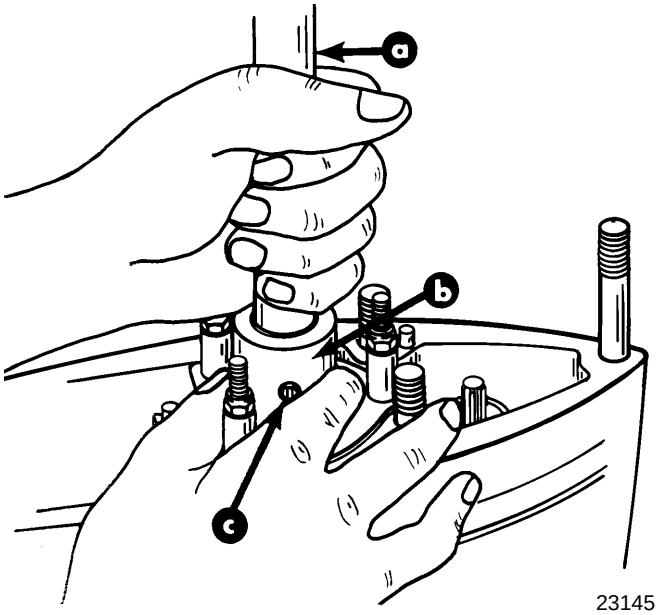
3. Place collar (from Bearing Preload Tool 91-44307A1) over drive shaft with set screw down. Align set screw with flat on drive shaft.



23145

a - Collar
b - Set Screw
c - Flat On Drive Shaft

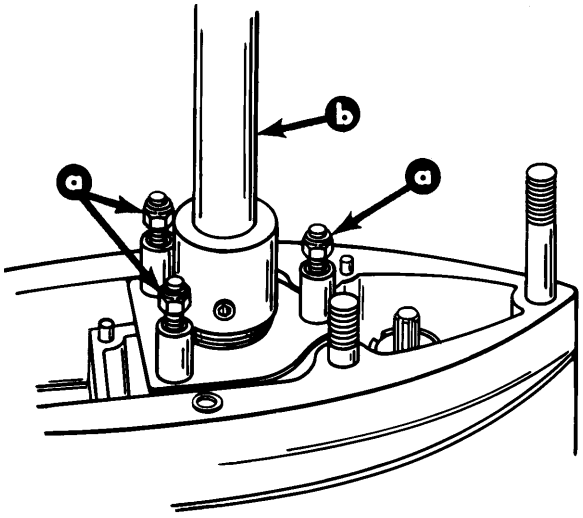
4. Pull up on drive shaft, push down on collar and tighten set screw.



23145

a - Drive Shaft
b - Collar
c - Set Screw

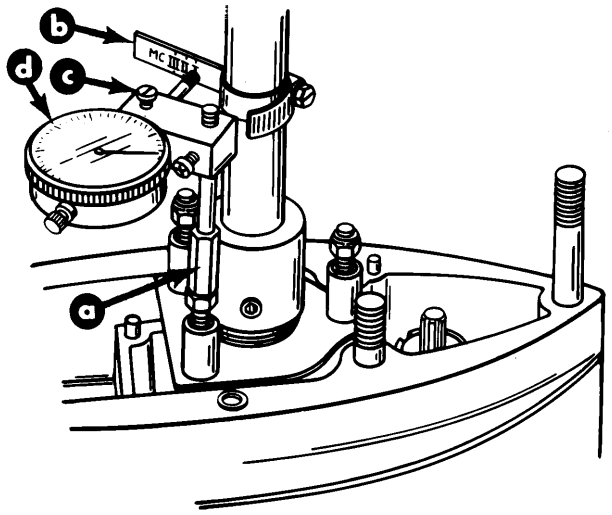
5. Back off nuts 3-4 turns and turn drive shaft clockwise 2 or more turns to seat bearings.



23146

a - Nuts (3)
b - Drive Shaft

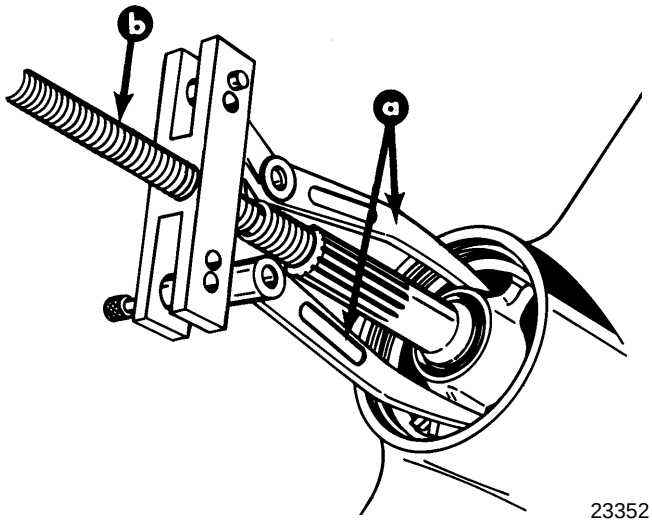
6. Install dial indicator as follows:
   a. Thread stud adaptor all the way onto stud. Make sure adaptor is snug.
   b. Install Backlash Indicator Rod, Dial Indicator Holding Tool and Dial Indicator as shown.
   c. Position Dial Indicator Pointer to line marked “I” on Backlash indicator Rod.



23146

a - Stud Adaptor (91-13948)
b - Backlash Indicator Rod (91-53459)
c - Dial Indicator Holding Tool (91-89897)
d - Dial Indicator (91-58222A1)

7. Apply forward pressure to propeller shaft as follows:
   a. Attach Puller Jaws and Puller Bolt onto bearing carrier bosses and propeller shaft.
   b. Torque bolt to 45 lb. in. (5 N·m).

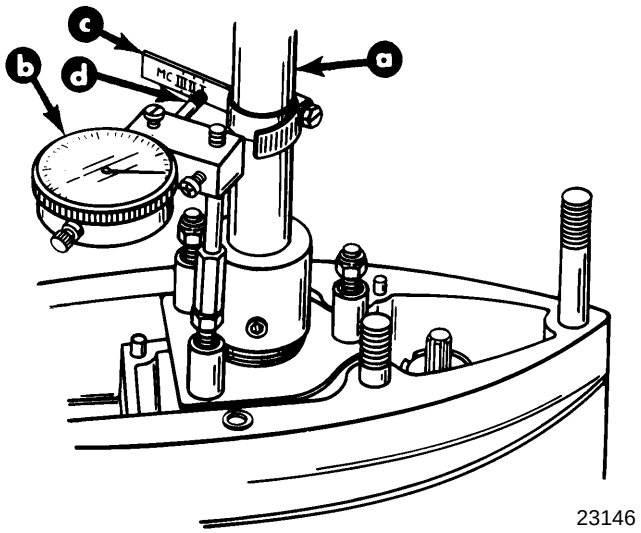


23352

a - Puller Jaws (91-46086A1)
b - Puller Bolt (91-58716)

8. Take backlash readings at 4 locations, rotating drive shaft 90 degrees at a time, as follows:
   a. Lightly turn drive shaft back and forth, so as to feel backlash between gears (no movement should be noticed at propeller shaft).
   b. Observe Dial Indicator. Reading must fall between .017-.028 in. (0.43-0.71 mm).

c. To ensure reliability of results, take 3 more backlash readings, turning drive shaft 90 degrees at a time. Be sure to loosen backlash indicator rod and realign Dial Indicator Pointer with mark “I” on rod.



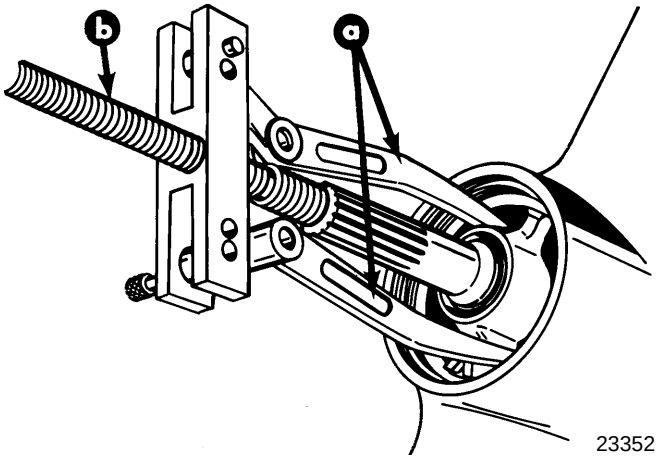
23146

a - Drive Shaft
b - Dial Indicator
c - Indicator Rod
d - Indicator Pointer

9. Perform step a, b or c following:
   a. **If Backlash is Less than Required,** remove appropriate shim thickness from forward gear bearing cup.
   b. **If Backlash is More than Required,** add appropriate shim thickness to forward gear bearing cup.
   c. **If Backlash is Within Specification,** proceed to “CHECKING REVERSE GEAR BACKLASH” following.

NOTE: *By adding or subtracting .001 in. (0.025 mm) shim, the backlash will change approximately .001 in. (0.025 mm).*

10. Remove Puller Jaws and Puller Bolt from propeller shaft.

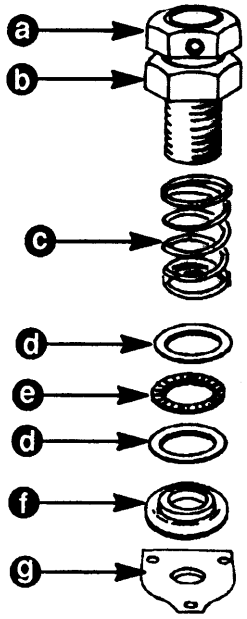


23352

a - Puller Jaws
b - Puller Bolt

CHECKING REVERSE GEAR BACKLASH

Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.



73885

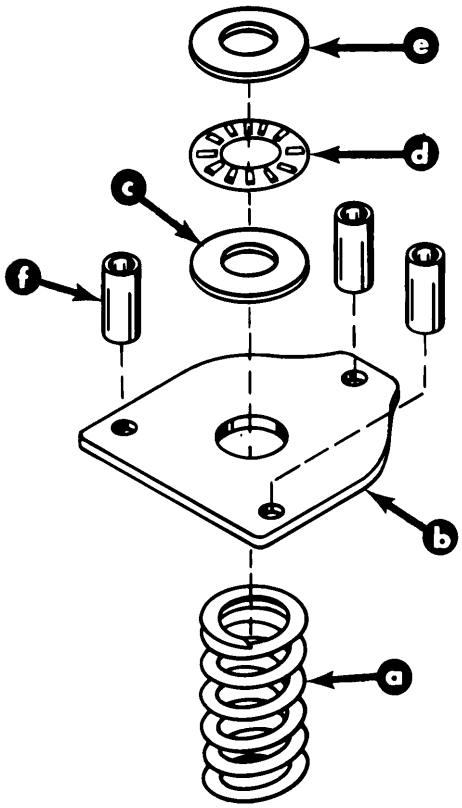
Current Style Preload Tool Installation

a - Top Nut With Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer
g - Water Pump Face Plate (From Your Gear Housing)

Early Style Preload Tool Installation

NOTE: *If checking reverse gear backlash immediately following forward gear backlash, steps 1-6 are not necessary, as preload tool and dial indicator assembly are already in place.*

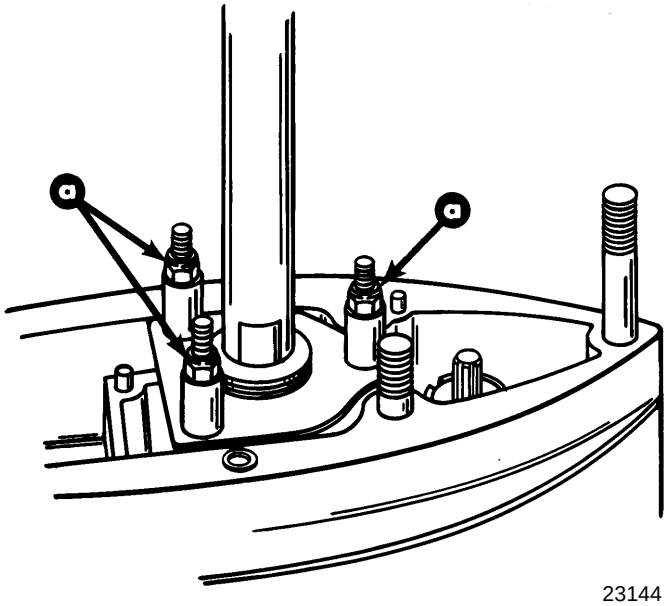
1. Install the following components from Bearing Preload Tool (91-44307A1) over drive shaft in order shown.



23144

a - Spring
b - Plate
c - Washer
d - Bearing
e - Washer
f - Spacers (3)

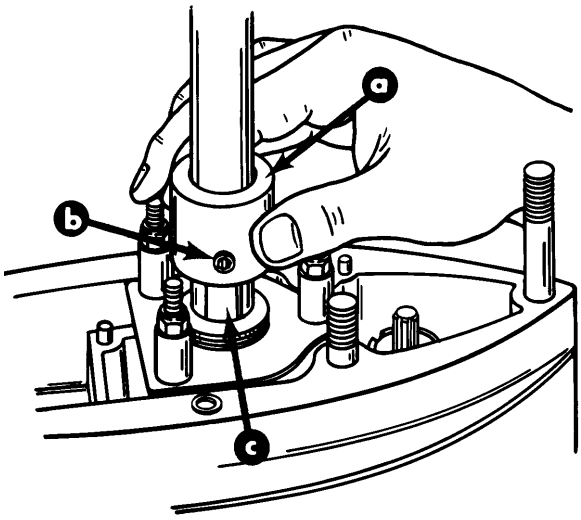
2. Install and tighten nuts until they just bottom on spacers.



23144

a - Nuts (3)

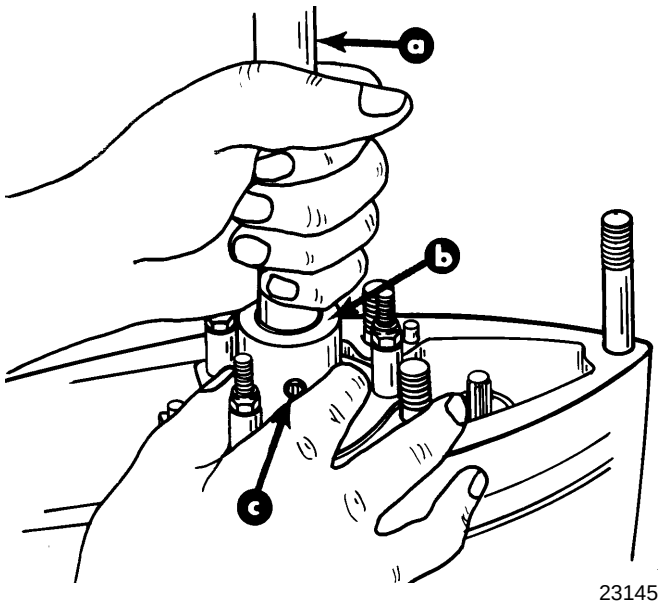
3. Place collar from Bearing Preload Tool (91-44307A1) over drive shaft with set screw down. Align set screw with flat on drive shaft.



23145

a - Collar
b - Set Screw
c - Flat on Drive Shaft

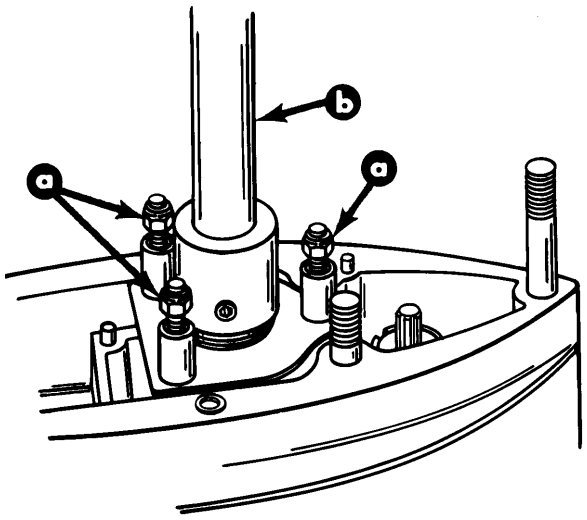
4. Pull up on drive shaft, push down on collar and tighten set screw securely.



23145

a - Drive Shaft
b - Collar
c - Set Screw

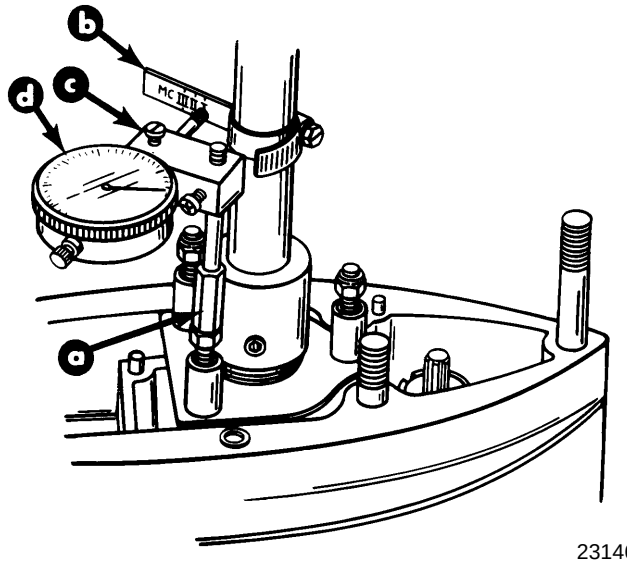
5. Back off nuts 3-4 turns and turn drive shaft 2 or more turns to seat bearings.



23146

a - Nuts (3)
b - Drive Shaft

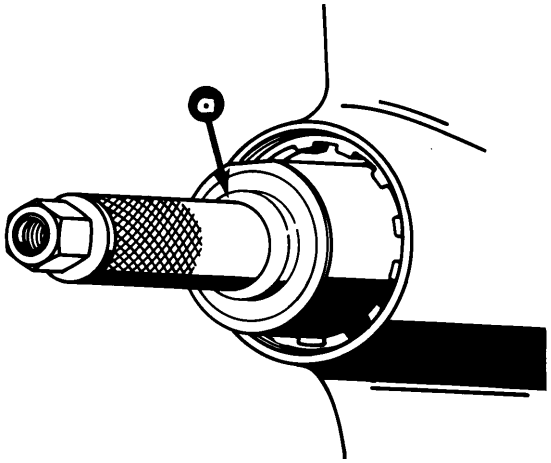
6. Install dial indicator as follows:
   a. Thread stud adaptor all the way onto stud. Make sure adaptor is snug.
   b. Install backlash indicator rod, dial indicator holding tool and dial indicator as shown.
   c. Position dial indicator pointer to line marked “I” on backlash indicator rod.



23146

a - Stud Adaptor (91-44307A1)
b - Backlash Indicator rod (91-53459)
c - Dial Indicator Holding Tool (91-89897)
d - Dial Indicator (91-58222A1)

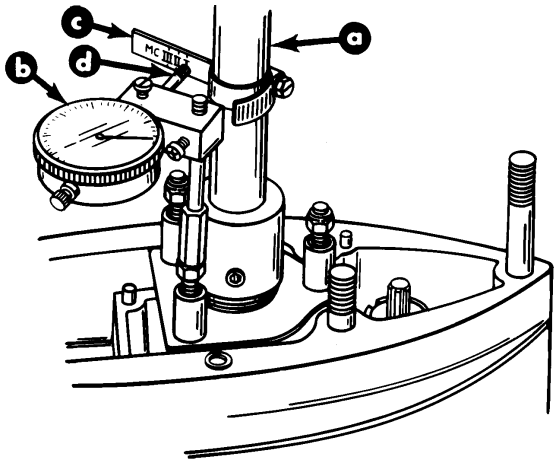
7. Apply backward pressure on propeller shaft as follows:
   a. Install pinion nut adaptor tool, washer and propeller nut as shown.
   b. Torque propeller nut to 45 lb. in. (5 N·m).



23355

a - Pinion Nut Adaptor Tool

8. Take backlash readings at 4 locations, rotating drive shaft 90 degrees at a time, as follows:
   a. Lightly turn drive shaft back and forth, so as to feel backlash between gears (no movement should be noticed at propeller shaft).
   b. Observe dial indicator. Reading must fall between .028-.052 in. (0.71-1.32 mm).
   c. To ensure reliability of results, take 3 or more backlash readings, turning drive shaft 90 degrees at a time. Be sure to loosen backlash indicator rod and realign dial indicator pointer with line marked “I” on indicator rod.



23146

a - Drive Shaft
b - Dial Indicator
c - Indicator Rod
d - Indicator Pointer

9. Perform step a, b or c following.
   a. **If Backlash is Less than Required,** add appropriate thickness shims (from Shim Pack P/N 15- 31535A1) between gear housing and bearing carrier.
   b. **If Backlash is More than Required,** check for improper installation of bearing carrier. If carrier is installed properly, it will be necessary to replace gear housing.
   c. **If Backlash is Within Specifications,** proceed to next step.

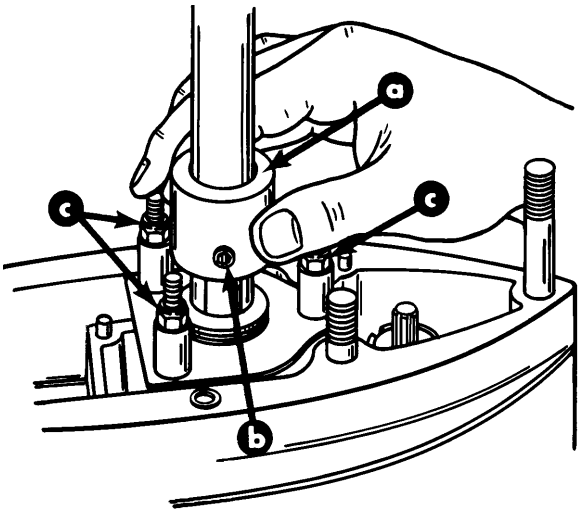
NOTE: *By adding .001 in. (0.025 mm) shim, the backlash will change approximately .001 in. (0.025 mm).*

10. Remove pinion nut adaptor tool from propeller shaft.
11. Remove dial indicator and associated tools.

⚠CAUTION

Before loosening collar set screw, tighten preload tool nuts until they bottom on spacers.

12. Remove bearing preload tool as follows:
    a. Tighten nuts until they bottom on threads.
    b. Loosen collar set screw and remove collar.
    c. Remove nuts and remaining preload tool components.

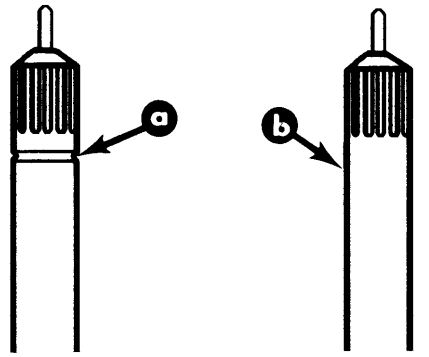


23145

a - Collar
b - Set Screw
c - Nuts (3)

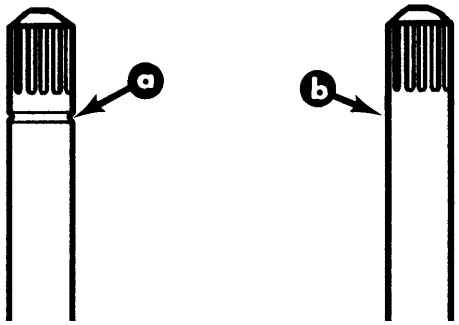
ALPHA I and MC I DRIVE SHAFT CHANGES

The service drive shaft for the lower unit will no longer have an O-ring groove at the top of the shaft under the splines on all Alpha One 1990 and prior and also MC I through 1976. All present production units contain the New Style shaft without an O-ring groove also.



71185

a - MC I Old Style (With O-ring Groove)
b - Mc L New Style (Without O-ring Groove)

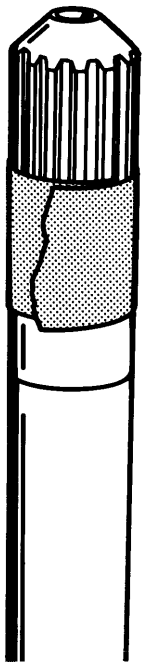


71185

a - Alpha One Old Style (With O-ring Groove)
b - Alpha One New Style (Without O-ring Groove)

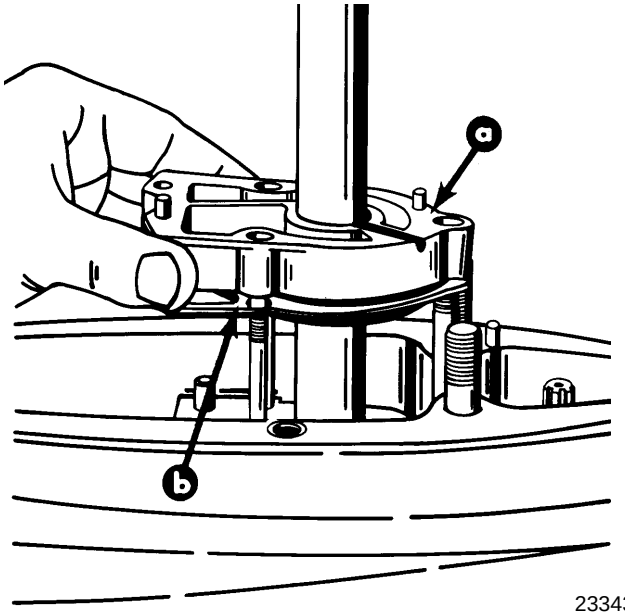
WATER PUMP INSTALLATION

1. If O-ring is present, cover drive shaft O-ring groove with a piece of tape.



50312

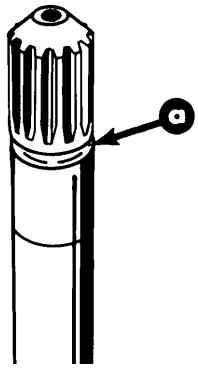
2. Lubricate water pump base oil seal lips with 2-4-C Marine Lubricant with Teflon and install water pump base with gasket over drive shaft.



23343

a - Water Pump Base
b - Gasket

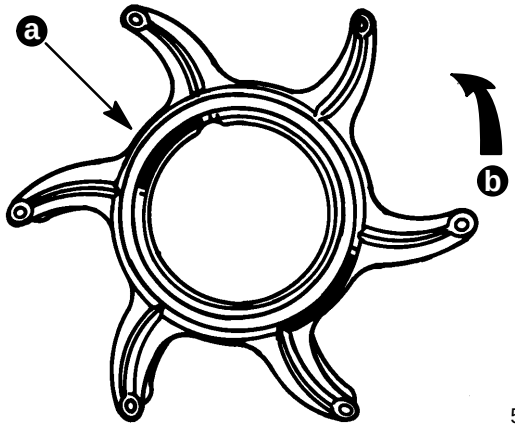
3. Remove tape from drive shaft O-ring groove.



23343

a - O-ring Groove (If O-ring Groove Is Present)

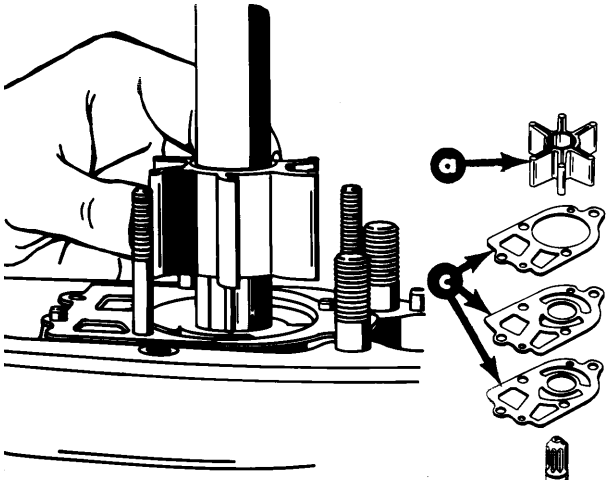
IMPORTANT: When completing repair which required removal of water pump impeller, it is recommended that the impeller be replaced. If it becomes necessary to reuse an impeller, DO NOT install reversed from original rotation, or premature impeller failure will occur. Face the curl of the blades in a counterclockwise direction.



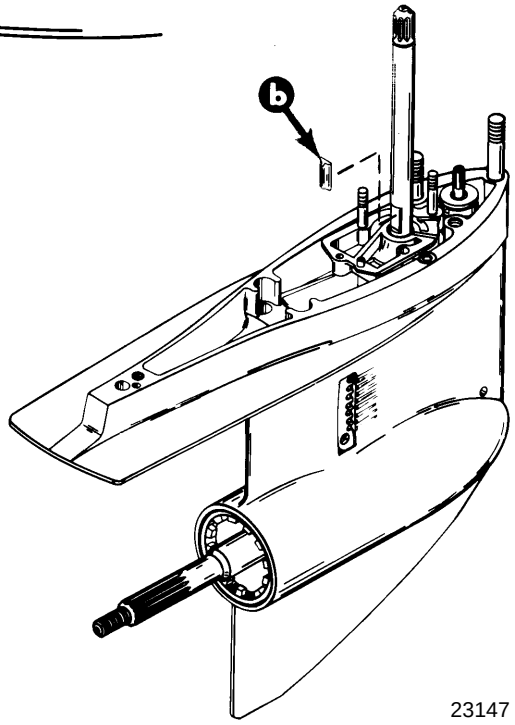
50312

a - Impeller
b - Counterclockwise Direction

4. Install gaskets and face plate with one gasket on each side of face plate and lip on face plate facing toward water pump base.
5. Place a small dab on 2-4-C Marine Lubricant with Teflon on drive key and place key on flat of drive shaft.
6. Slide water pump impeller over drive shaft.
7. Align impeller key-way with key and set impeller on face plate.



23356

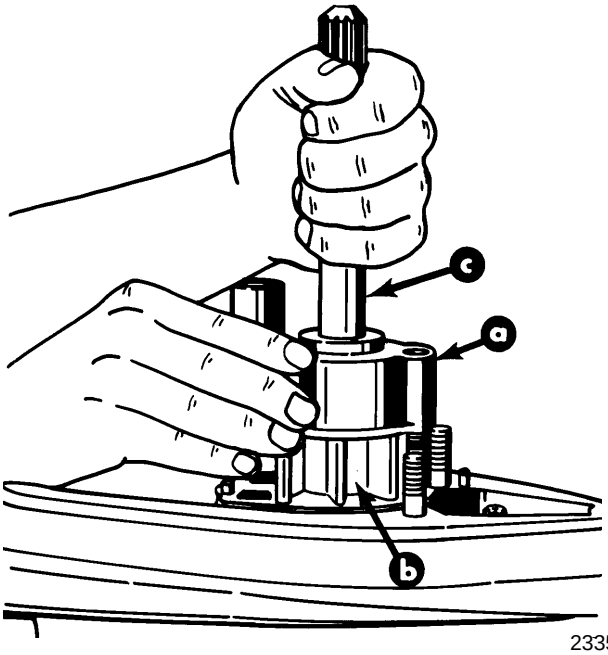


23147

a - Water Pump Impeller
b - Key
c - Water Pump Face Plate And Gaskets (One On Each Side)

8. Lightly lubricate water pump body insert with 2-4-C Marine Lubricant with Teflon.

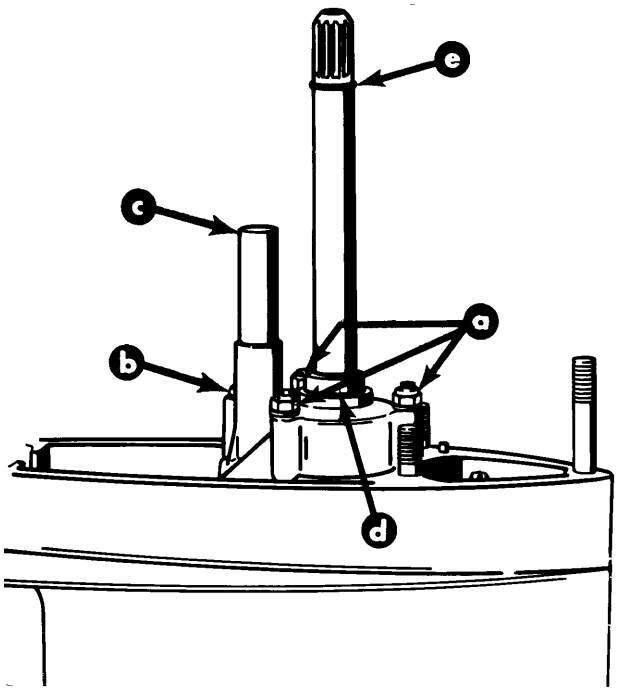
9. Position water pump body over drive shaft and water pump studs. Rotate drive shaft in a clockwise direction, while pushing down on water pump body to ease impeller entry into body.



23350

a - Water Pump Body
b - Water Pump Impeller
c - Drive Shaft

10. Install components as shown. Torque nuts to 60-80 lb. in. (6.8-9 N·m) and torque screw to 30-40 lb. in. (3.4-4.5 N·m).

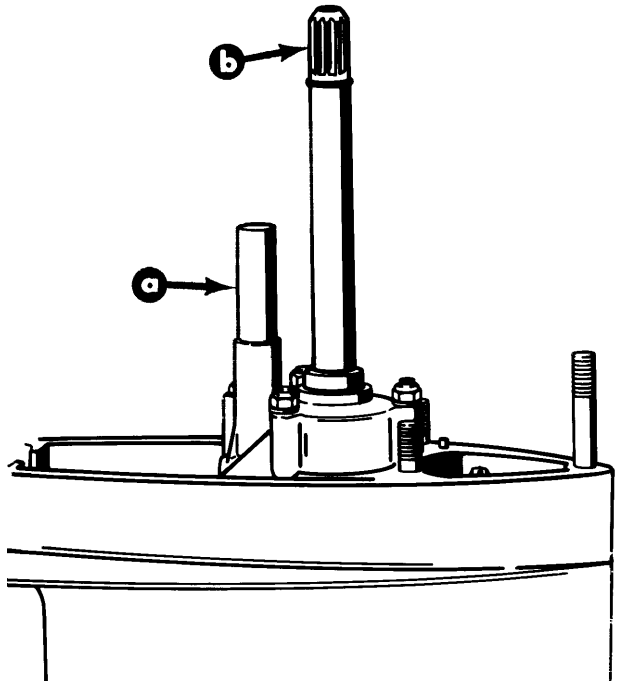


23266

a - Flat Washers and Nuts (3)
b - Screw
c - Water Tube (Plastic)
d - Centrifugal Slinger
e - O-ring (If O-ring Groove Is Present)

Gear Housing Installation

1. Lubricate end of water tube and drive shaft splines with 2-4-C Marine Lubricant.

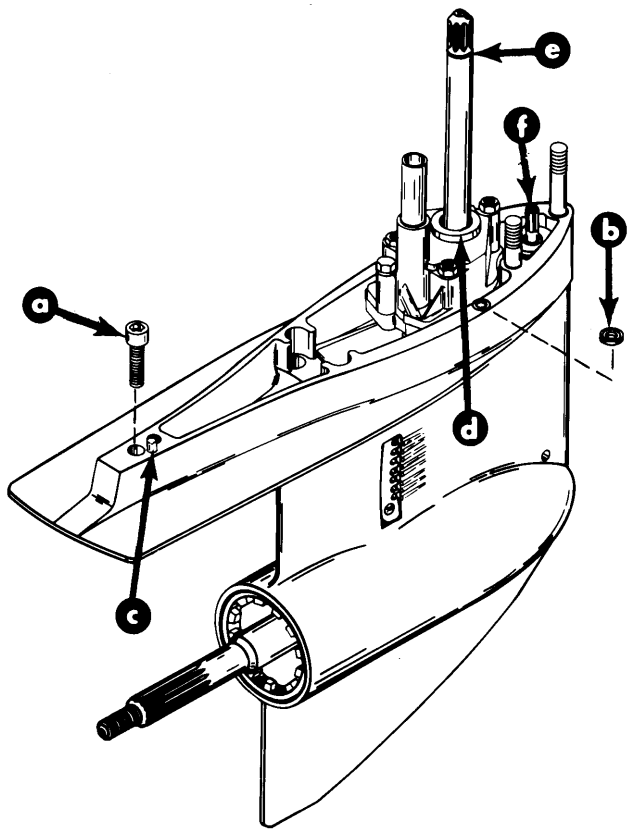


23266

a - Water Tube
b - Drive Shaft Splines - DO NOT Lubricate Top Of Drive Shaft

2. Install trim tab allen screw.
3. Install oil seal and apply Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal to oil seal.
4. Check that alignment pins, centrifugal slinger and drive shaft O-ring are in place (if O-ring and O-ring groove are present).
5. Move gear housing shift shaft clockwise to shift gear housing into forward gear.

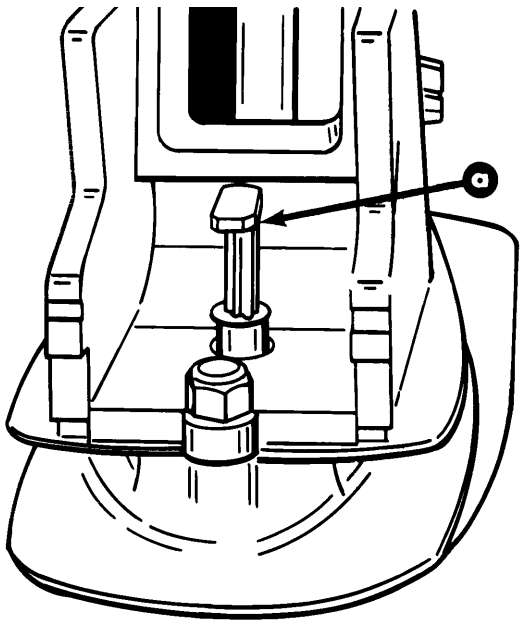
NOTE: *Gear housing may be held in forward gear by applying light pressure to propeller shaft in counter-clockwise direction.*



23138

a - Trim Tab Allen Screw
b - Oil Seal
c - Alignment Pins
d - Centrifugal Slinger
e - O-ring (If O-ring Groove Is Present)
f - Shift Shaft

6. Place drive shaft housing shift shaft in the full forward position.



23265

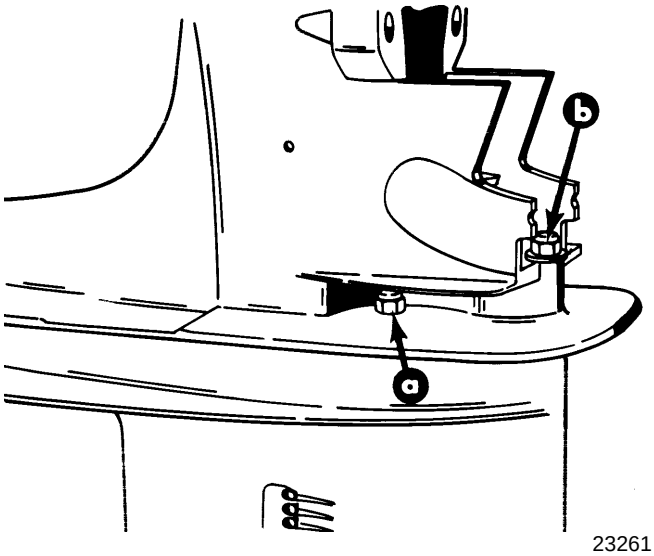
a - Shift Shaft

NOTE: *If propeller shaft is rotated in a clockwise direction before shift shafts are coupled, gear housing must be shifted back into forward gear and held in position.*

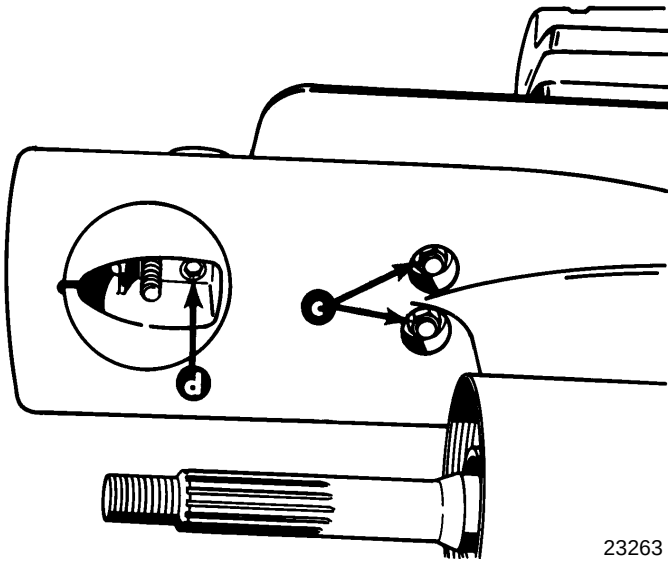
7. Align water tube with tube guide and drive shaft and shift shaft splines with upper drive shaft and shift shaft splines and install gear housing.

NOTE: *Rotate propeller shaft counterclockwise only after shift shaft splines have engaged. This will help engage drive shaft splines.*

8. Secure gear housing to drive shaft housing as shown.



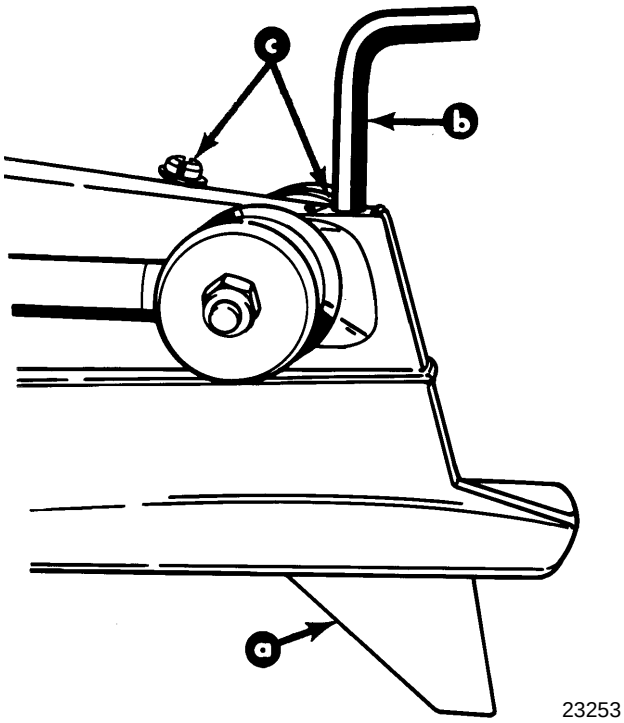
23261



23263

a - locknuts (One Each Side) - Torque To 35 lb. ft. (47 N·m)
b - locknut - Torque To 35 lb. ft. (47 N·m)
c - locknuts - Torque To 35 lb. ft. (47 N·m)
d - Allen Screw Torque To 28 lb. ft. (38 N·m)

9. Install trim tab and position according to marks made before disassembly. Torque to 30 lb. ft. (40 N·m). Reinstall plastic plug.



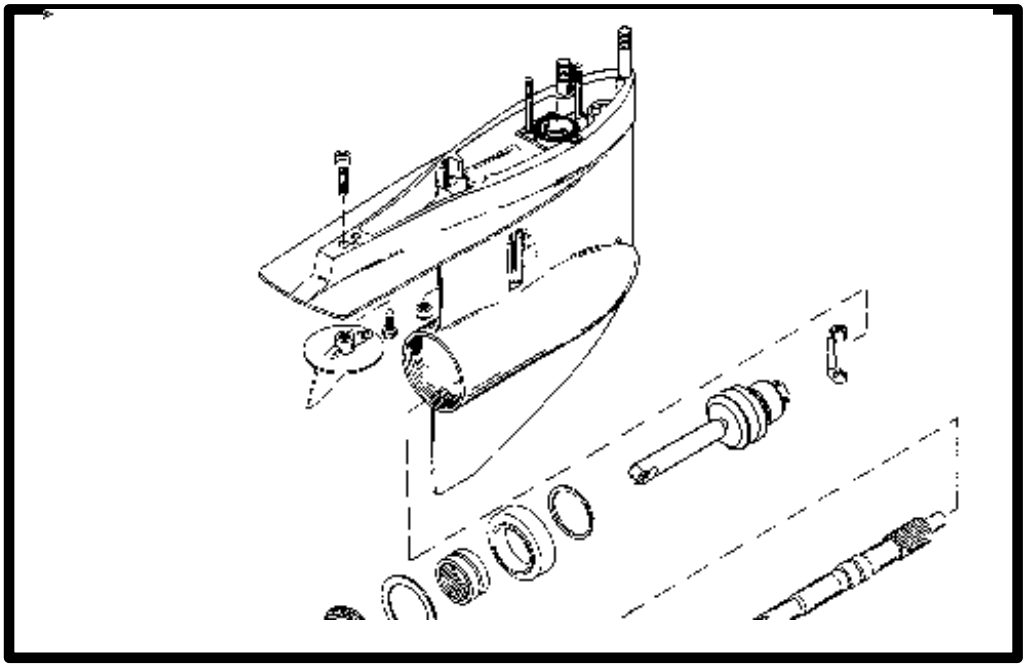
23253

a - Trim Tab
b - Allen Wrench
c - Plastic Plug

10. Refill drive unit with gear lubricant (Refer to Section 1-B).

STERNDRIVE UNIT

3
C



I-R GEAR HOUSING

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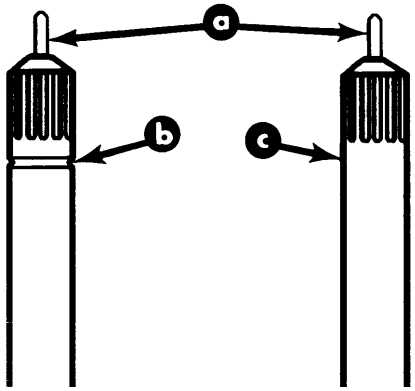
Identification

All MerCruiser I-R gear housings may be identified by the preload pin located on the drive shaft.



71185

“R” Gear Housing Identification

a - Drive Shaft Preload Pin
b - MC I Old Style (With O-ring Groove)
c - MC I New Style (Without O-ring Groove)

Specifications

Torque Specifications

Fastener	Torque
Nuts - Water Pump Body	60 - 90 lb. in. (7 - 10 N·m)
Screw - Water Pump Body	30 - 40 lb. in. (3 - 5 N·m)
Nut - Pinion Gear	60 - 80 lb. ft. (81 - 108 N·m)
Screw - Gear Housing to Drive Shaft Housing	28 lb. ft. (38 N·m)
Nuts - Gear Housing to Drive Shaft Housing	35 lb. ft. (47 N·m)
Screw - Trim Tab	23 lb. ft. (31 N·m)
Bushing - Shift Shaft	50 lb. ft. (68 N·m)
Retainer - Bearing Carrier	210 lb. ft. (285 N·m)

Shimming Specifications

Location	Specification
Forward Gear Backlash	.020 - .023 In. (0.51 - 0.58 mm)
Reverse Gear Backlash	.040 - .060 In. (1.01 - 1.52 mm)
Pinion Gear Height	.025 In. (0.64 mm)

Special Tools

Description	Part No.
Bearing Cup Installation Tool	91-18605A2
Shift Shaft Tool	75104A7
Backlash Indicator Rod	91-53459
Bearing Carrier Retainer Wrench	91-61069
Belleville Washer	12-54058
Dial Indicator	91-58222A1
Dial Indicator Holding Tool	91-89897
Drive Shaft Nut Wrench	91-56775
Drive Shaft Tapered Bearing Driver	91-87119
Driver Cup	91-34379
Driver Cup	91-36577
Needle Bearing Driver	91-33491
Oil Seal Driver	91-31108
Oil Seal Driver	91-44110
Pinion Gear Shimming Tool	91-56048
Pinion Nut Adaptor	91-61067A3
Puller Bolt	91-85716
Puller Jaws	91-46086A1
Shift Shaft Bushing Tool	91-31107
Slide Hammer Puller	91-34569A1
Torque Wrench - Lb. In.	91-66274
Universal Bearing Removal and Installation Tool (Components following)	91-312295A5
Bearing Adaptor	91-15755
Bearing Driver	91-52393
Bearing Driver	91-32336
Bearing Driver Rod	91-37323
Bearing Installation Tool	91-38628
Collar	91-30366-1
Driver Head	91-36569
Driver Head	91-37311
Driver Head	91-37312
Nut	11-24156
Pilot Washer	91-36571
Pilot Washer	91-37324
Pilot Washer	91-37350
Plate	91-29310
Puller Head	91-36379
Puller Rod	91-31229
Puller Rod Head	91-32325
Roller Bearing Removal and Installation Tool	91-37292
Washer	12-34961
Puller Rod	91-52394
Universal Puller Plate	91-37241
Guide Plate	91-816243

Lubricants/Sealers/ Adhesives

Description	Part No.
Quicksilver 2-4-C Marine Lubricant With Teflon	92-825407A12
3M Brand Adhesive	92-86166-1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
RTV Sealer / #587 Loctite	92-809825
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver High Performance Gear Lube	92-816026A1
Loctite 27131	92-809820

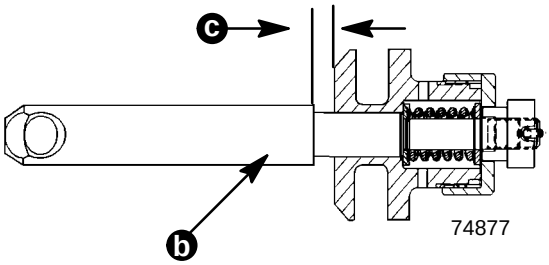
Special Information

⚠CAUTION

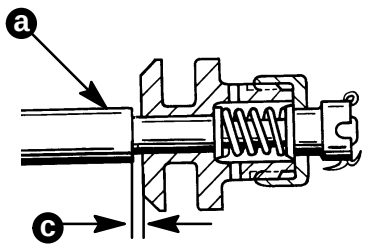
Avoid damage to sterndrive unit. Drive unit damage will occur if Later Style parts are intermixed with Earlier Style parts.

Shift Spool Assembly

The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool is sold as a whole assembly and can be used when replacing the earlier style. The end play for the spool will remain the same as the earlier models [.002-.010 in. (0.051-0.254 mm)].



74877

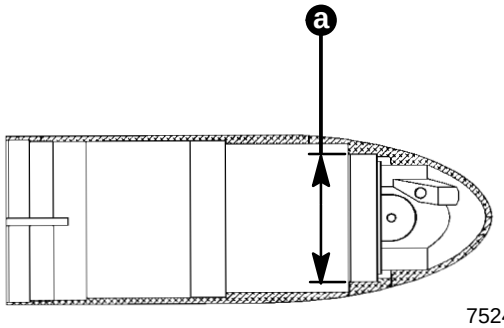


75219

a - Earlier Style Shift Spool Assembly (Prior To S/N 0K041000)
b - Later Style Shift Spool Assembly (S/N 0K041000 And Above)
c - Measure End Play Here

Forward Gear Bearing Bore

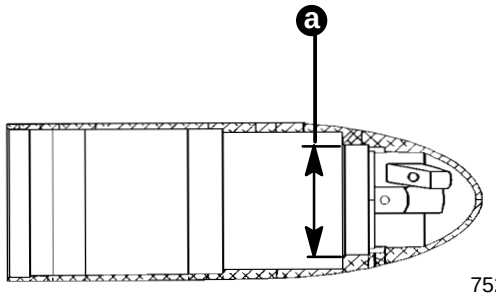
The later style forward gear bearing bore is smaller (3.2635 to 3.2650 in.) than the earlier style (3.4985 to 3.5000 in.) This slightly smaller bearing bore for the forward gear bearing adaptor is approximately 1/4 in. (6 mm) smaller.



75241

Earlier Style Forward Gear Bore (Prior to S/N 0F680153)

a - 3.4985 in. - 3.5000 in.

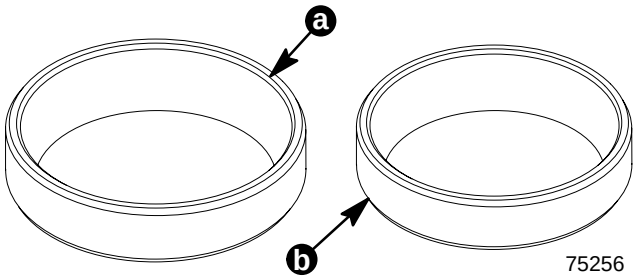


75248

Later Style Forward Gear Bore (S/N 0F680154 and Above)

a - 3.2635 in. - 3.2650 in.

The later style bearing cup is thinner and has a smaller diameter than the earlier style.



75256

a - Earlier Style Gear Bearing Cup 3.500 in. Diameter (Prior To S/N 0F680153)
b - Later Style Gear Bearing Cup 3.265 in. Diameter (S/N 0F680154 And Above)

The tables on the following pages list items that have been affected by the change.

The following is a supersession list to use when ordering the MCI or Alpha One lower gear housing as a **complete assembly** for replacement of the original lower unit.

Gear Housing Complete Supersession Listing				
Models	**Ratio**	**(Original) Gear Housing Assy Complete**	**Superseded by**	**Serial No. Range**
120	1.98:1	1623-5356A20	1623-8951A43	4893635 and up
140	1.98:1	1623-5356A20	1623-8951A43	4893635 and up
165	1.65:1	1623-5356A20	1623-8951A43	4890460 and up
470	1.84:1	1623-5356A20	1623-8951A43	4893835 and up
485	1.84:1	1623-5356A20	1623-8951A43	4893835 and up
225 - S	1.50:1	1623-5356A3	1623-8951A43	3856268 thru 4200499
228	1.50:1	1623-5356A3	1623-8951A43	4782330 and up
228	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
233	1.32:1	1623-8951A2	1623-8951A43	4200500 and up
250	1.32:1	1623-5356A3	1623-8951A43	4791300 and up
250	1.32:1	1623-8951A2	1623-8951A43	4791300 and up
260	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
888	1.50:1	1623-4110A6	1623-8951A43	3784374 and below
888	1.50:1	1623-4110A13	1623-8951A43	3784375 thru 3909577
888	1.50:1	1623-5356A3	1623-8951A43	3909578 and up
898	1.50:1	1623-8951A2	1623-8951A43	4782330 and up
898	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
470	1.84:1	1623-5356A3	1623-8951A43	4208730 and up
470	1.84:1	1623-8951A2	1623-8951A43	4208730 and up
R	ALL	1623-5356A20	1623-8951A43	6225577 and up
MR	ALL	1623-5356A20	1623-8951A43	6225577 and up
Alpha One	ALL	1623-8951A23	1623-8951A43	6225577 and up
Alpha One	ALL	1623-8951A14	1623-8951A43	6225577 and up

The following is a supersession list to use when ordering the **Gear Housing Only** for replacement of the original lower unit.

Gear Housing Only Supersession List				
Models	**Ratio**	**(Original) Gear Housing Only**	**Superseded by**	**Serial No. Range**
120	1.98:1	1623-5356A4	None Required	4893635 and up
140	1.98:1	1623-5356A4	None Required	4893635 and up
165	1.65:1	1623-5356A4	None Required	4890460 and up
470	1.84:1	1623-5356A4	None Required	4893835 and up
470	1.84:1	1623-5356A4	None Required	4208730 and up
470	1.84:1	1623-5356A4	None Required	4208730 and up
485	1.84:1	1623-5356A4	None Required	4893835 and up
225 - S	1.50:1	1623-5356A4	None Required	3856268 thru 4200499
228	1.50:1	1623-5356A4	None Required	4782330 and up
228	1.50:1	1623-5356A4	None Required	4898730 and up
233	1.32:1	1623-5356A4	None Required	4200500 and up
250	1.32:1	1623-5356A4	None Required	4791300 and up
250	1.32:1	1623-5356A4	None Required	4791300 and up
260	1.50:1	1623-5356A4	None Required	4898730 and up
888	1.50:1	1623-4110A3	1623-5356A4	3784374 and below
888	1.50:1	1623-4110A3	1623-5356A4	3784375 thru 3909577
888	1.50:1	1623-5356A4	None Required	3909578 and up
898	1.50:1	1623-5356A4	None Required	4782330 and up
898	1.50:1	1623-5356A4	None Required	4898730 and up
R	ALL	1623-5356A4	None Required	6225577 and up
MR	ALL	1623-8951A15	1623-8951A37	6225577 and up
Alpha One	ALL	1623-8951A27 (Black)	1623-8951A37	6225577 and up
Alpha One	ALL	1623-8951A14 (Oyster)	1623-8951A37	6225577 and up

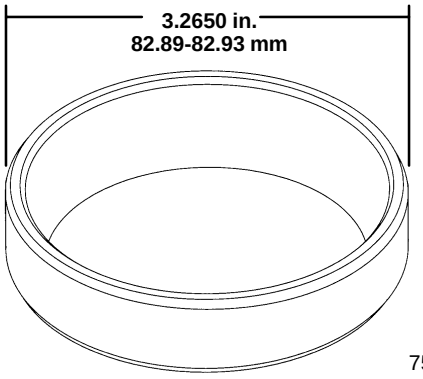
Before ordering a replacement **Gear Housing Only** for any of the previously listed units, you will need to look in the housing, at the cavity in front of the trim tab screw hole, for the casting number.

Order the appropriate housing number after determining the casting number.

GEAR HOUSING ONLY	
If Casting Number:	**Order Housing Number:**
1623-8950C 2	1623-8951A37
1623-8266C	1623-5356A4
1623-815822C 3	1623-815822A30

NOTE: *All of the numbers listed above are on the parts Micro-Fiche card.*

The 1623-815822A6 Gear Housing Only supersedes to 1623-815822A30. The A30 housing includes one 31-828439A2 forward gear bearing that allows you to install the 17/28 gears and the 14/28 gears into the new housing which has a 3.2635 - 3.2650 inch O.D. (82.89-82.93 mm) forward gear bearing bore.



75256B

Bearing Cup 31-828439A2

When Ordering Gear Housing:	FWD. Gear Bearing Supersedes To:	Current Part Number:
1623-8951A27 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	1623-8951A37 3.2635-3.2650 in. O.D. (82.89-82.93 mm) Fwd. Gr. Brg.
1623-815822A6 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	1623-815822A30 3.2635-3.2650 in. O.D. (82.89-82.93 mm) Fwd. Gr. Brg.

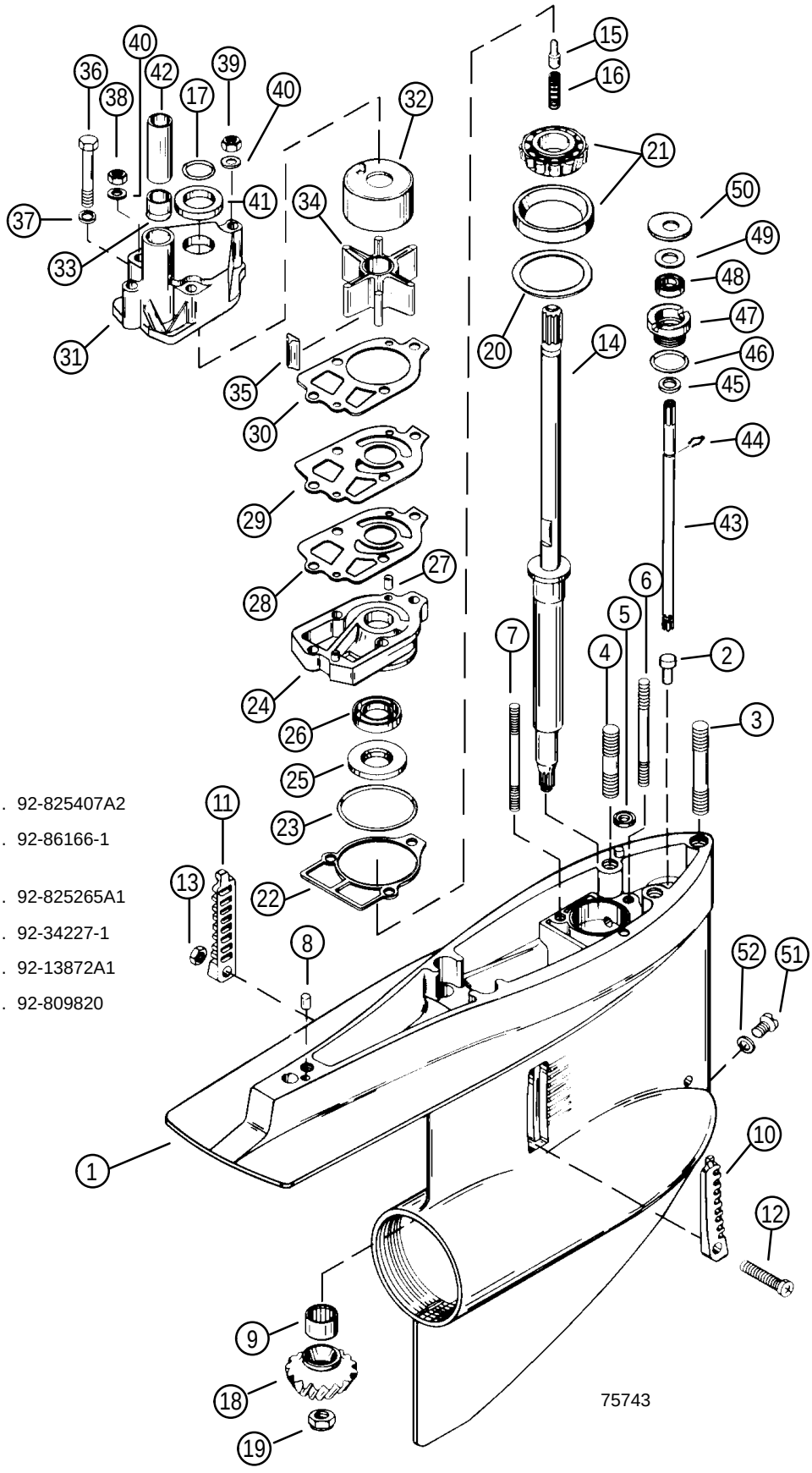
When Ordering Gear Housing:	Along With:	Gear Set	Also Requires:	Forward Gear Bearing
1623-8951A27 3.4895 - 3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	43-828072A2 or 43-828072A3 (13/21)	➔	31-30894A1 3.2635 - 3.2650 in. OD. (82.89-82.93 mm) Fwd. Gr. Brg.
1623-815822A6 3.4895 - 3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	43-828072A2 or 43-828072A3 (13/21)	➔	31-30894A1 3.2635 - 3.2650 in. OD. (82.89-82.93 mm) Fwd. Gr. Brg.

Torque Specifications

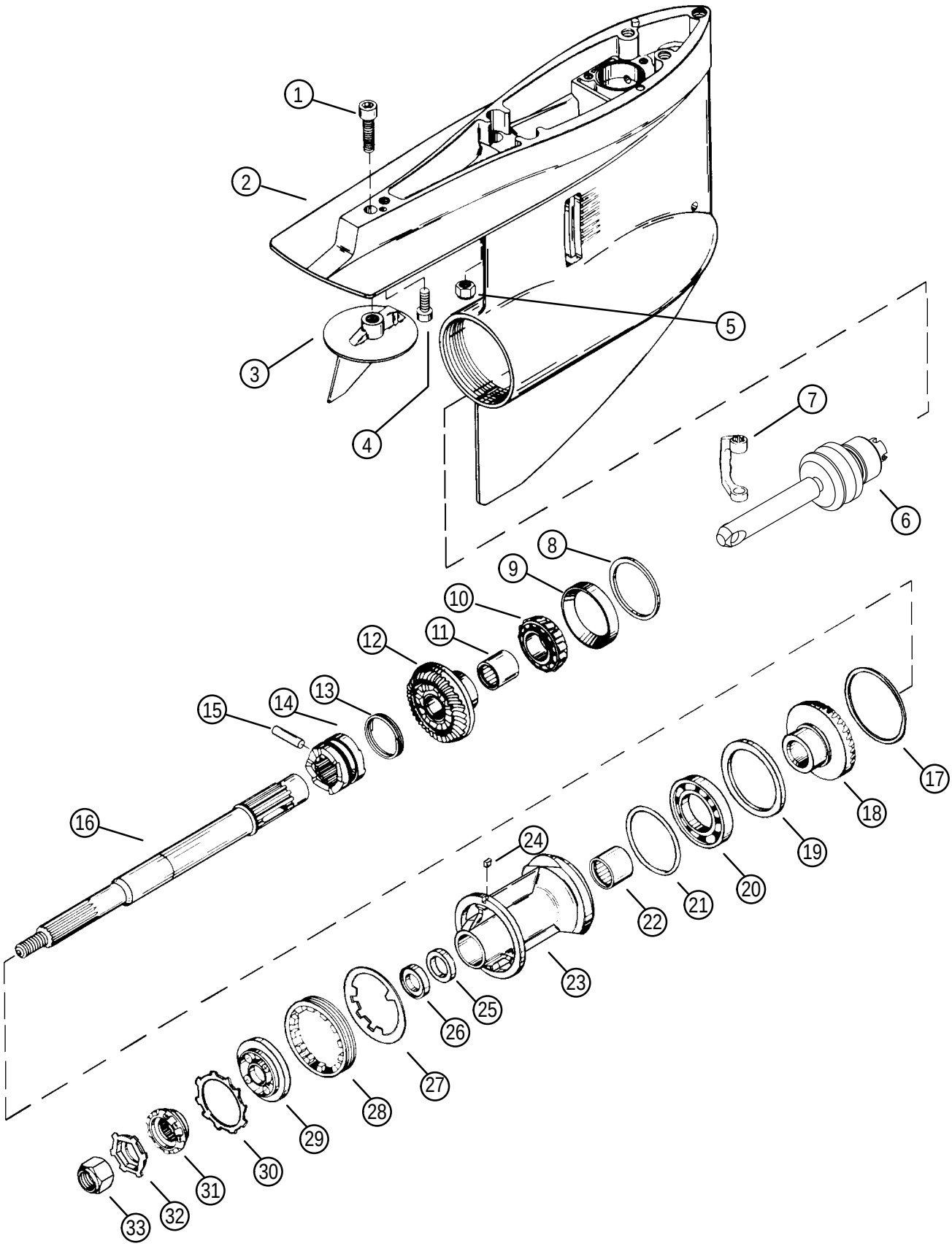
- a — 60 - 80 lb. ft. (81 - 108 N·m)
- b — 30 lb. in. (3 N·m)
- c — 60 - 80 lb. in. (6-9 N·m)
- d — 28 lb. ft. (38 N·m)
- e — 35 lb. ft. (47 N·m)
- f — 23 lb. ft. (31 N·m)
- g — 50 lb. ft. (68 N·m)
- h — 200 lb. ft. (285 N·m)
- i — 30 - 50 lb. in. (3-5 N·m)

Lubricants/Sealers/Adhesives

A	Quicksilver 2-4-C Marine Lubricant	92-825407A2
B	3M Brand Adhesive	92-86166-1
C	Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
D	Quicksilver Perfect Seal	92-34227-1
E	Quicksilver Special Lubricant 101	92-13872A1
F	Loctite 27131	92-809820



1 - Gear Housing Assembly
2 - Shift Crank Pin
3 - Gear Housing Stud
4 - Gear Housing Stud
5 - Gear Housing Seal
6 - Water Pump Stud
7 - Water Pump Stud
8 - Dowel Pin
9 - Roller Bearing
10- Water Pickup Insert
11- Water Pickup Insert
12- Insert Screw
13- Insert Nut
14- Drive Shaft Assembly
15- Drive Shaft Pin
16- Compression Spring
17- O-ring
18- Gear Set (Pinion and Forward Gear)
19- Nut
20- Shim
21- Tapered Roller Bearing Assembly
22- Gasket
23- O-ring
24- Water Pump Base Assembly
25- Oil Seal
26- Oil Seal
27- Dowel Pin
28- Lower Gasket
29- Face Plate
30- Gasket
31- Water Pump Body Assembly
32- Water Pump Insert
33- Rubber Seal
34- Impeller
35- Key
36- Screw
37- Washer
38- Nut
39- Nut
40- Washer
41- Rubber Ring
42- Guide Sleeve
43- Lower Shift Shaft
44- Retaining Clip
45- Washer
46- O-ring
47- Bushing Assembly
48- Oil Seal
49- Washer
50- Washer
51- Screw
52- Washer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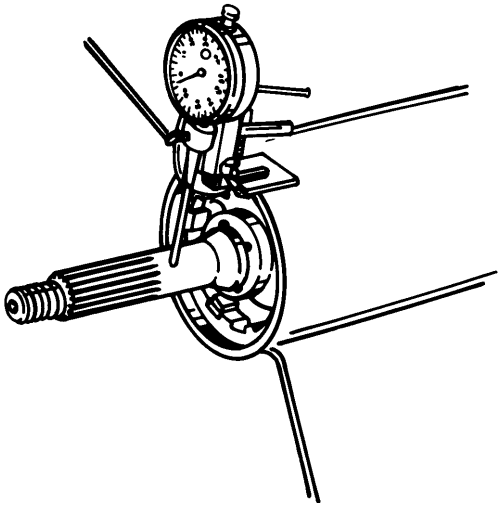
75744

1 - Trim Tab Screw
2 - Gear Housing Assembly
3 - Trim Tab Assembly
4 - Screw
5 - Nut
6 - Shift Spool Assembly
7 - Shift Crank
8 - Shim
9 - Tapered Roller Bearing
10- Tapered Roller Bearing
11- Forward Gear Roller Bearing
12- Forward Gear
13- Cross Pin Retainer Spring
14- Clutch
15- Cross Pin
16- Propeller Shaft
17- Shim
18- Reverse Gear
19- Thrust Ring
20- Ball bearing
21- O-ring
22- Roller Bearing
23- Bearing Carrier
24- Key
25- Oil Seal
26- Oil Seal
27- Tab Washer
28- Gear Housing Cover
29- Thrust Hub
30- Lockwasher
31- Spline Washer
32- Tab Washer
33- Propeller Nut

Pre-Disassembly Inspection

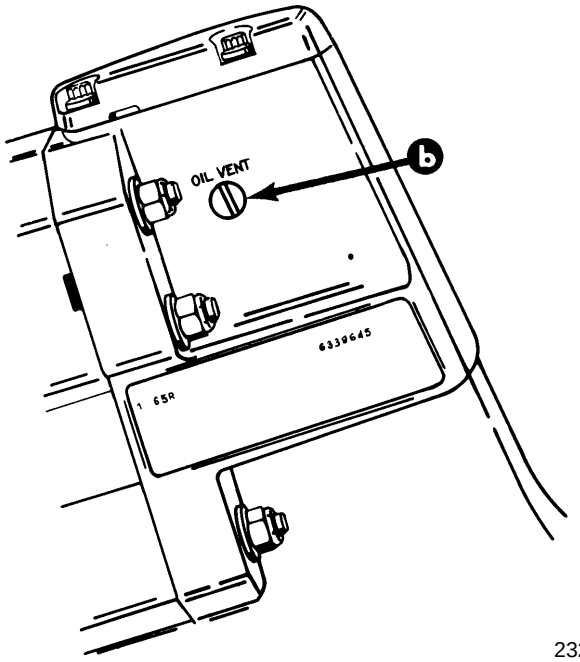
1. Check propeller shaft for side to side movement, as follows:
   a. Position dial indicator on propeller shaft.
   b. Push propeller shaft to one side and zero the dial indicator.
   c. Move propeller shaft to opposite side while observing dial indicator. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than .003 in. (0.08 mm) indicates the following:
      - Worn propeller shaft bearings
      - Bent or otherwise damaged propeller shaft
      - Improper propeller shaft preload
2. Check for a bent propeller shaft, as follows:
   a. Rotate propeller shaft while observing dial indicator. If deflection is more than .005 in. (0.127 mm), a bent propeller shaft is indicated.



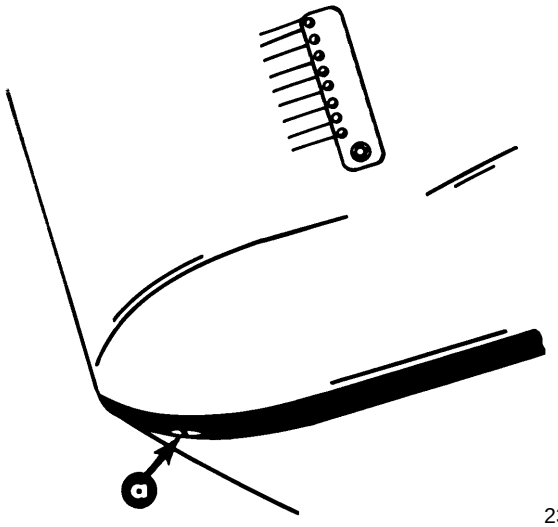
22086

Separate Drive Shaft Housing From Gear Housing

1. Tilt drive unit at a 45 degree angle, remove fill/drain plug; then remove oil vent screw. Allow drive unit to drain completely.



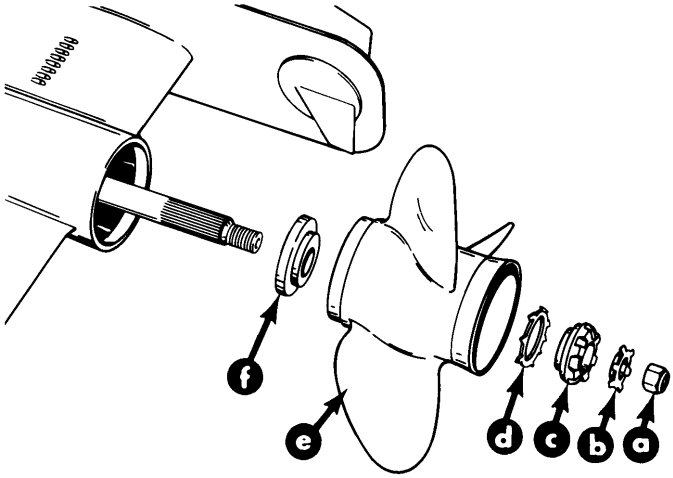
23263



23266

a - Fill/Drain Screw
b - Vent Screw

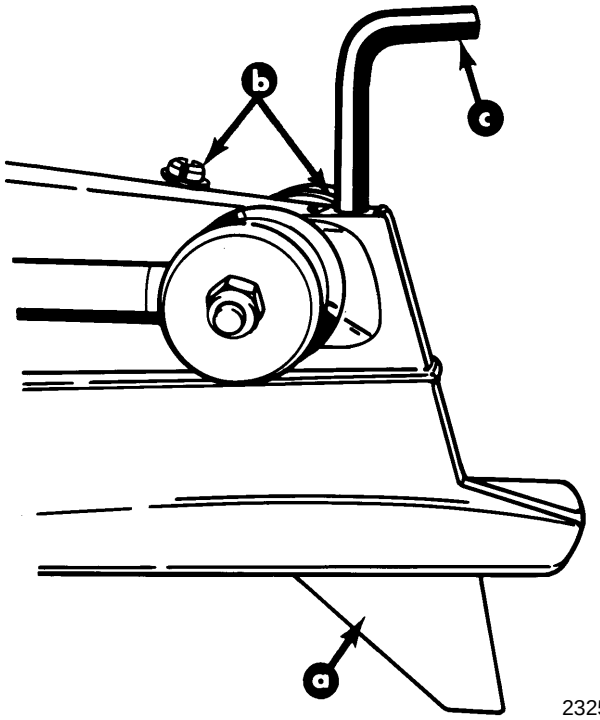
2. Remove propeller.



22074

a - Propeller Nut
b - Tab Washer
c - Spline Washer
d - Continuity Washer
e - Propeller
f - Thrust Hub

3. Mark trim tab position with a piece of tape; then remove trim tab.

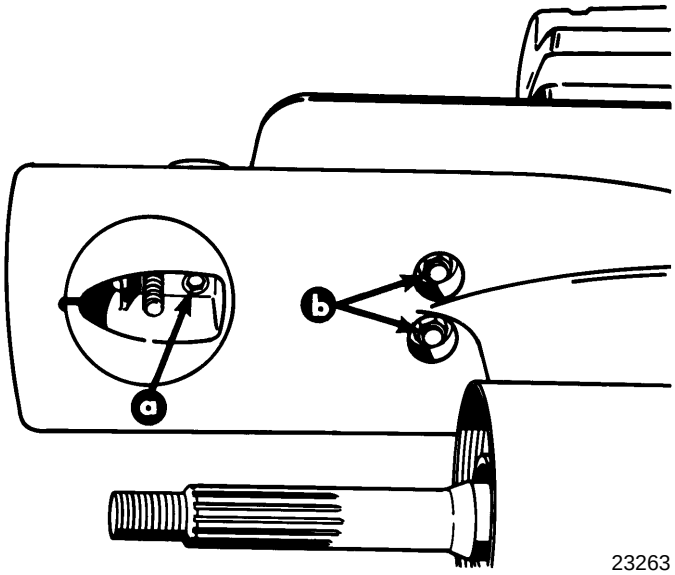


23253

a - Trim Tab
b - Plastic Plug (From Access Hole)
c - 3/8 in. Allen Wrench

4. Remove gear housing as follows:

a. Remove allen screw and locknuts from bottom side of gear housing.



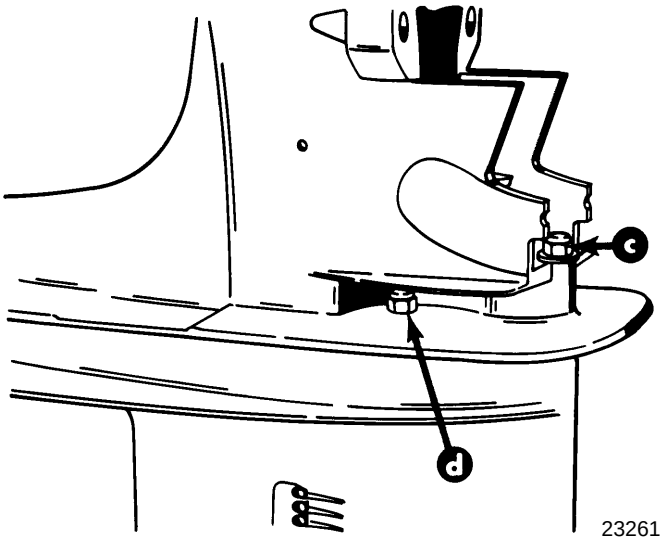
23263

a - Allen Screw (In Trim Tab Cavity)
b - Locknuts

b. Remove locknut from front side of drive shaft housing.

c. Loosen locknuts (one on each side of gear housing). DO NOT attempt to remove one nut before opposite side is loosened sufficiently or drive shaft housing could be damaged.

d. Pull gear housing away from drive shaft housing as far as nuts will allow. Remove loosened nuts.



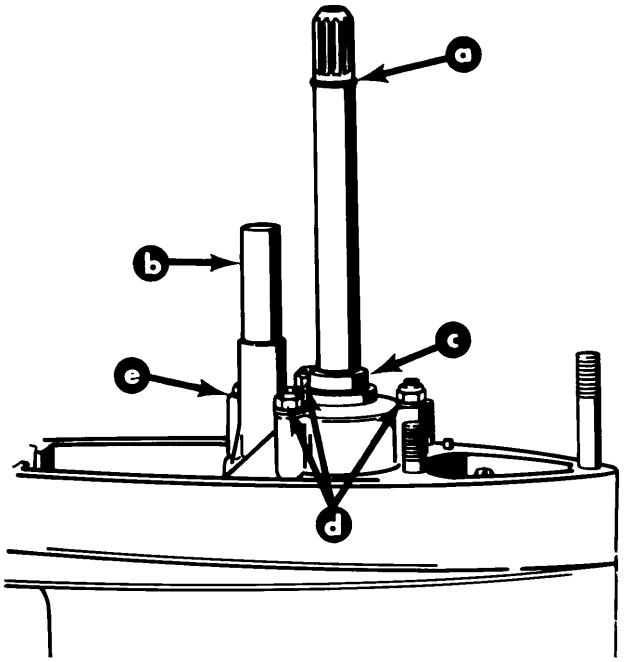
23261

a - Locknut (Top Front)
b - Locknuts (One Each Side)

Gear Housing Disassembly

NOTE: *If O-ring remains lodged between upper drive shaft seals (in drive shaft housing), be sure to remove O-ring or reassembly will be impaired.*

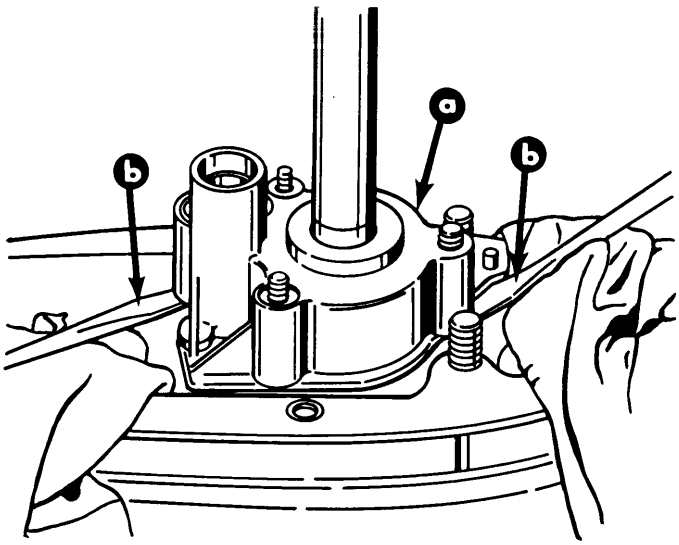
1. Remove components shown.



23266

a - O-ring (On Units With O-ring Groove)
b - Water Tube
c - Rubber Centrifugal Slinger
d - Locknuts (3)
e - Self-Tapping Screw

2. Carefully, lift water pump body from gear housing.

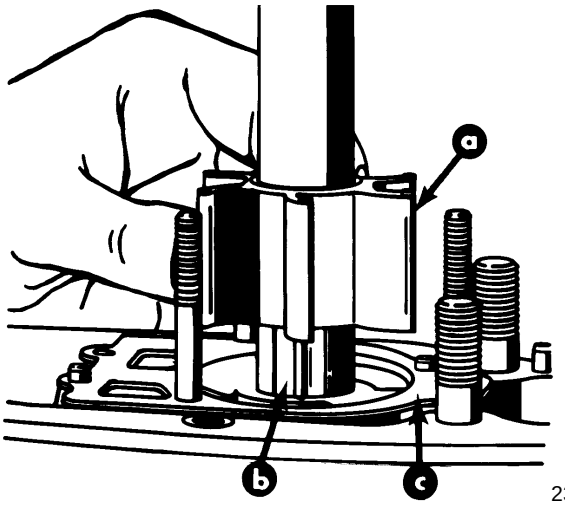


23349

a - Water Pump Body
b - Pry Bars

3. Remove water pump impeller.

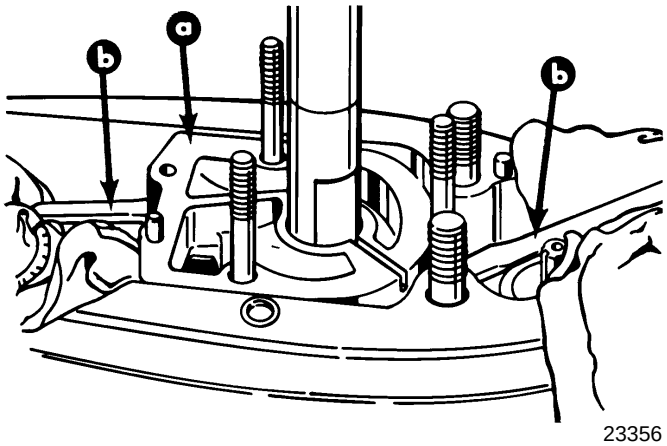
NOTE: *It may be necessary to use a punch and hammer to drive impeller upward on drive shaft. In extreme cases, it may be necessary to split hub of impeller with hammer and chisel.*



23356

a - Water Pump Impeller
b - Drive Key
c - Water Pump Face Plate And Gaskets
(One On Each Side Of Face Plate)

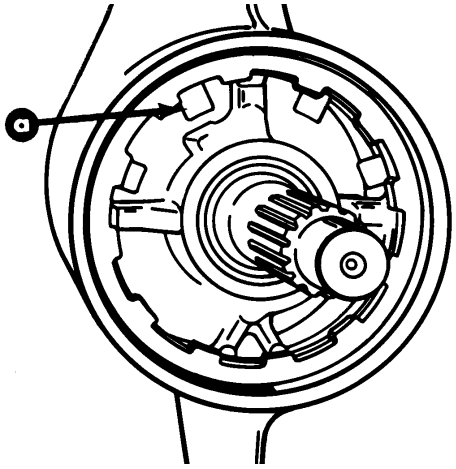
4. Remove water pump base from gear housing.



23356

a - Water Pump Base
b - Pry Bars

5. Straighten tabs on bearing carrier tab washer.

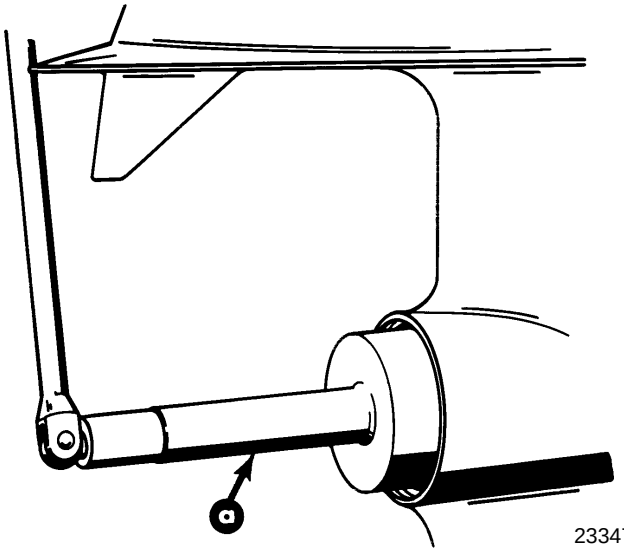


50312

a - Tab On Tab Washer

6. Remove bearing carrier retainer following step “a” or “b” as follows:

   a. Remove bearing carrier retainer using bearing carrier retainer wrench (P/N 91-61069).



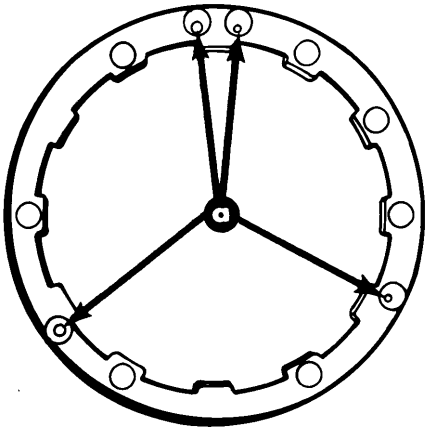
23347

a - Bearing Carrier Retainer Wrench

⚠CAUTION

DO NOT drill into gear housing retainer threads if using following procedure for removing retainer.

   b. If retainer is corroded in place, drill 4 holes in retainer and fracture retainer with a chisel. Pry out remaining segments.



23356

a - Drilled Holes

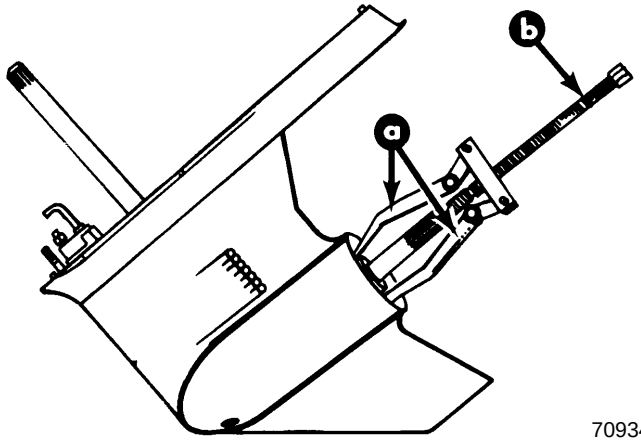
FOR EARLY STYLE UNITS:

⚠CAUTION

DO NOT pull on bearing carrier outer ring, as damage to carrier will result.

   c. Pull the bearing carrier from the gear housing by pulling on the **inner bosses** located on the center area by the oil seals.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



70934

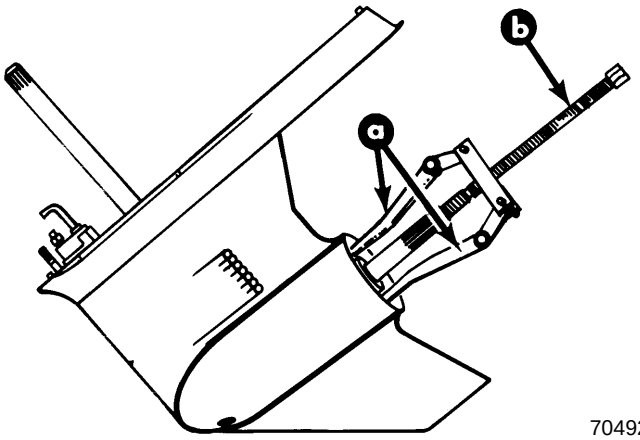
Previous Style Units

a - Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)

FOR CURRENT STYLE UNITS:

d. Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



70492

Current Style Units

a - Puller Jaws (P/N 91-46086A1)
b - Puller Bolt (P/N 91-85716)

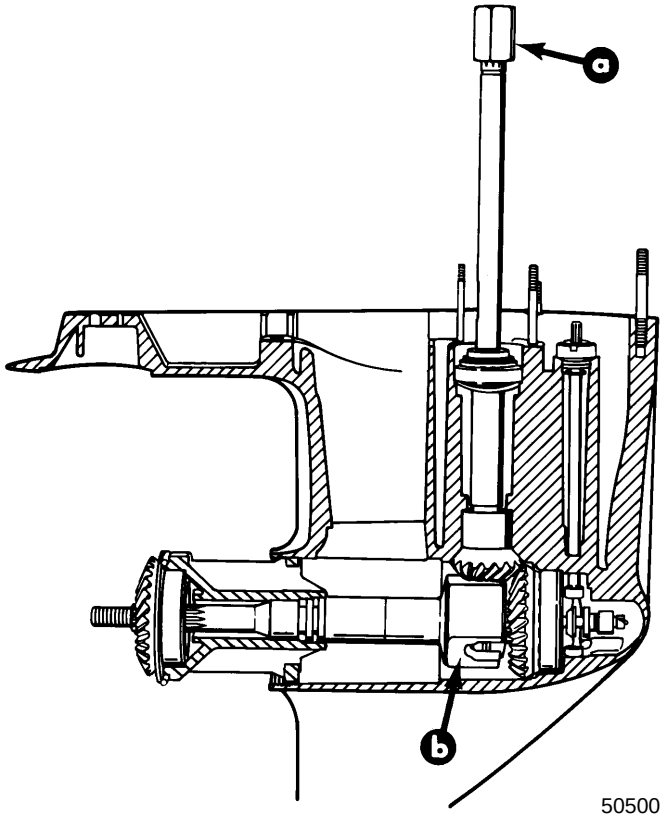
7. Remove drive shaft pinion nut as follows:

   a. Place drive shaft nut wrench over drive shaft splines with MC I slot towards the pinion gear.

   b. Pull up on drive shaft. Place pinion nut adaptor over propeller shaft and onto pinion gear nut with the MC I slot towards the pinion gear.

   c. Install the bearing carrier backwards in the gear case to support the propshaft and keep the pinion nut adaptor aligned.

   d. Turn drive shaft counterclockwise to remove pinion nut.

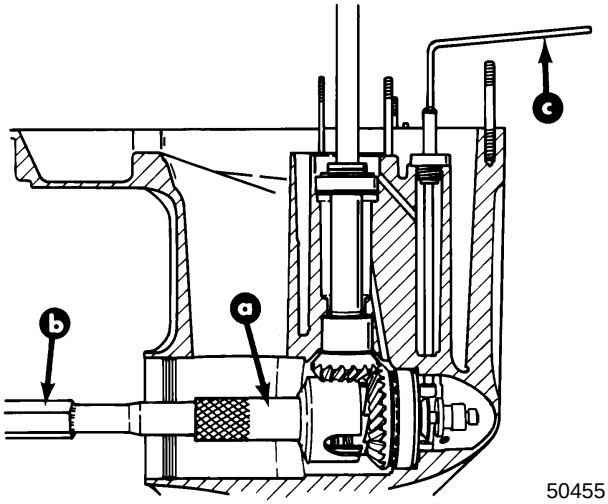


50500

a - Drive Shaft Nut Wrench (91-56775)
b - Pinion Nut Adaptor (91 -61 067A2)

e. **If Drive Shaft is Broken:** Place pinion nut adaptor over propeller shaft and onto pinion nut. Shift gear housing into forward gear. Turn propeller shaft counterclockwise to turn gears, thus removing pinion nut.

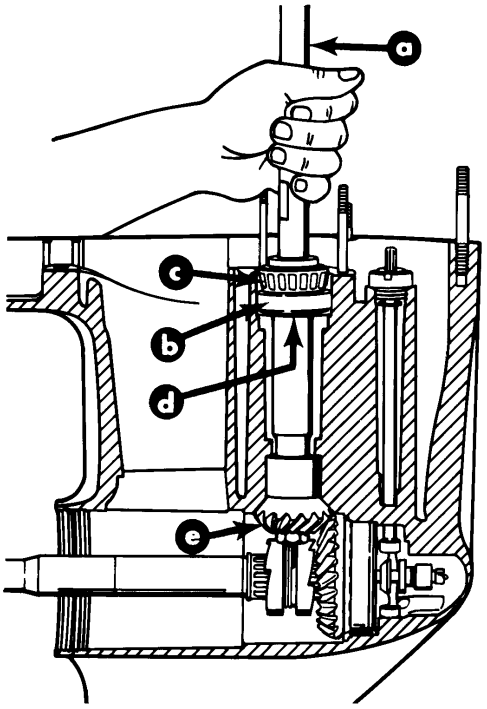
NOTE: *Propeller Shaft Tool 91-61077 is included with pinion nut adaptor 91-61067A3.*



50455

a - Pinion Nut Adaptor (91-61067A2)
b - Propeller Shaft Tool (91-61077)
c - Turn Clockwise (For Forward Gear)

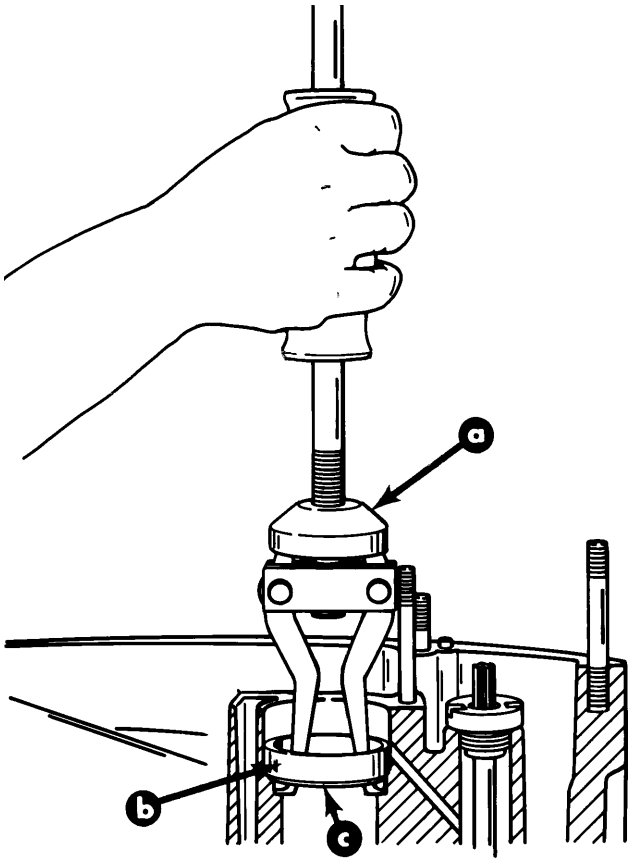
8. Remove pinion gear, drive shaft and tapered roller bearing.



50502

a - Drive Shaft
b - Bearing Cup
c - Bearing
d - Shims
e - Pinion Gear

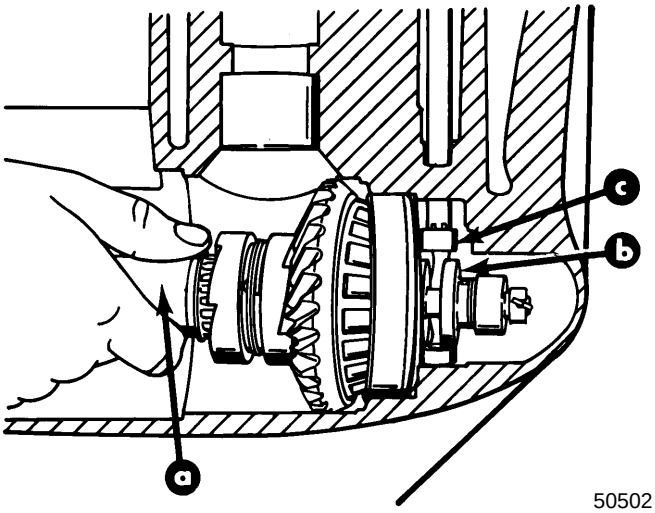
9. Remove bearing cup and shims.



50456

a - Slide Hammer Puller 91-34569A1
b - Bearing Cup
c - Shims

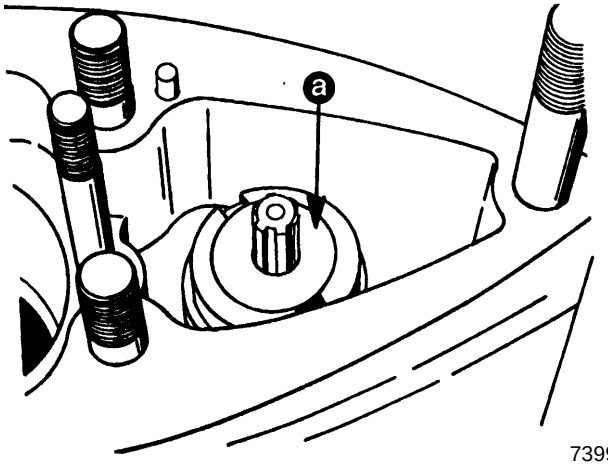
10. Remove propeller shaft and forward gear assembly.



50502

a - Propeller Shaft - Move To The Left To Disengage Shift Spool From Shift Crank
b - Shift Spool
c - Shift Crank

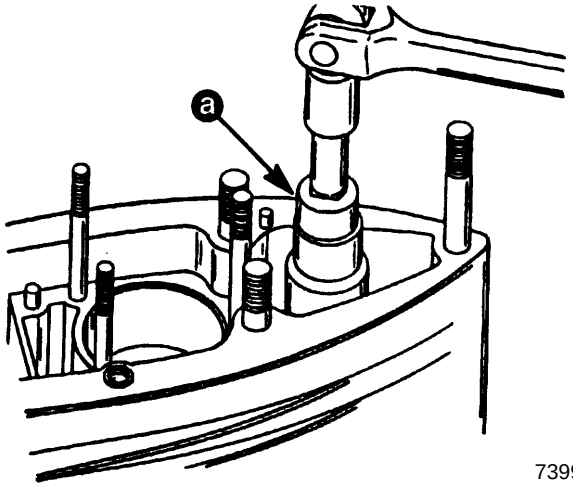
11. Remove shift shaft metal washer and rubber washer.



73993

a - Metal Washer And Rubber Washer (Under Metal Washer)

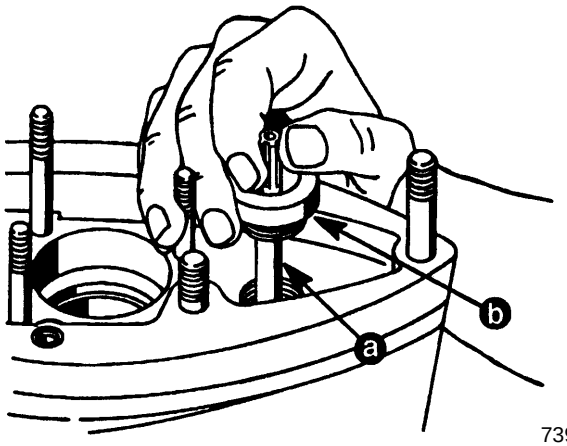
12. Loosen shift shaft bushing.



73992

a - Shift Shaft Bushing Tool (91-31107)

13. Lift shift shaft assembly and shift shaft bushing from gear housing. Remove shift crank from gear housing.



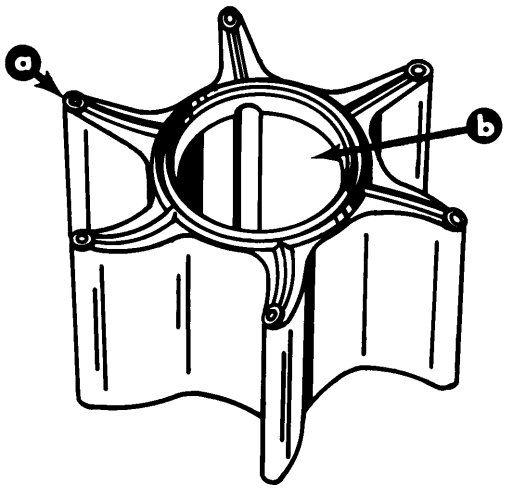
73990

a - Shift Shaft Assembly
b - Shift Shaft Bushing

Component Servicing

WATER PUMP INSPECTION

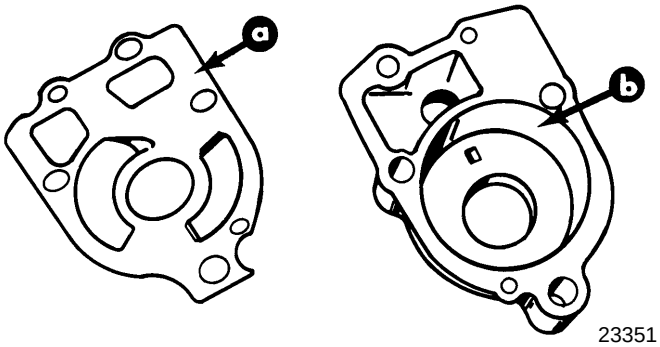
1. Check water pump impeller for wear on end of impeller blades and on top and bottom edge of blades.
2. Check for proper bonding between hub and impeller.
3. Replace impeller if blades have taken a set (hard and deformed).



50312

a - Water Pump Impeller
b - Hub (Changed From Aluminum To Fiber)

4. Inspect water pump face plate and insert for roughness and grooves.
5. Replace parts if defects are found.

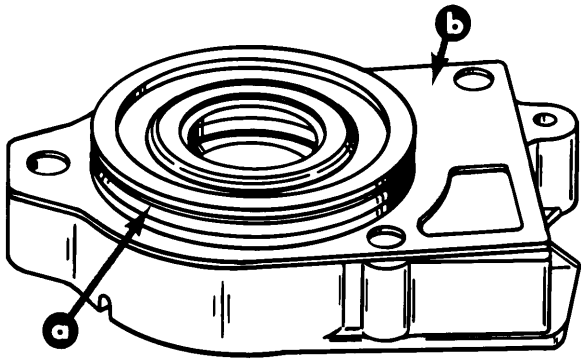


23351

a - Water Pump Face Plate
b - Insert

WATER PUMP DISASSEMBLY

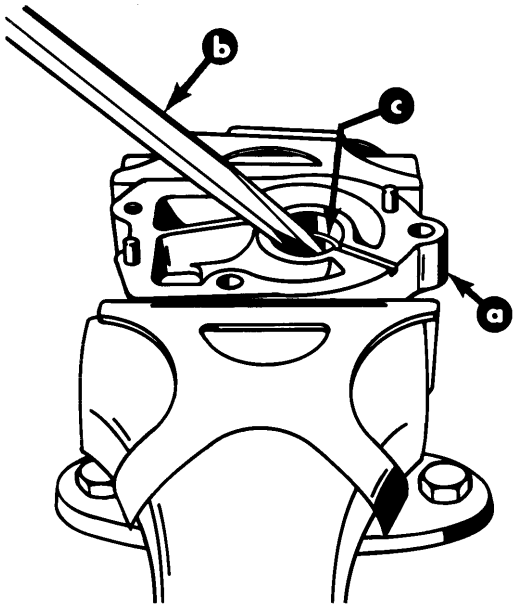
1. Remove water pump base O-ring and gasket.



23348

a - O-ring
b - Gasket

2. Remove water pump base oil seals using a screw driver to pry each one out individually.



23347

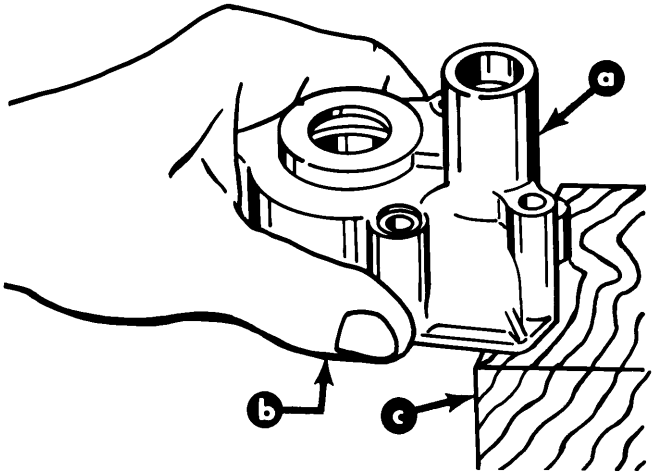
a - Water Pump Base
b - Screw Driver
c - Oil Seals (2)

3. If water pump insert required replacement, follow Method “A” or “B” following.

NOTE: *Try Method “A” first. If insert cannot be removed following Method “A”, use Method “B”.*

METHOD “A”:

Hold firmly onto water pump body, remove insert by squarely and firmly tapping body on a hard surface.

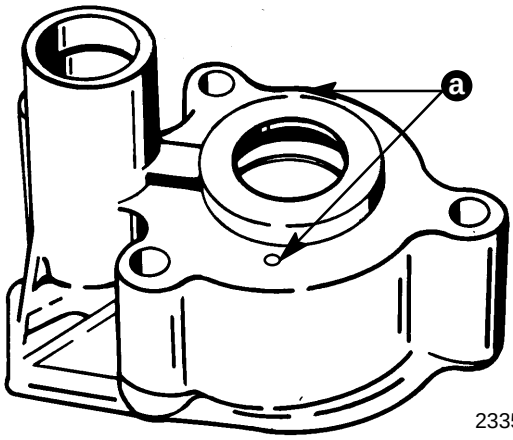


23355

a - Water Pump Body
b - Insert
c - Hard Surface (Wood Block)

METHOD “B”

Drill two 3/16 in. (5 mm) holes through water pump body - **DO NOT drill through insert**. Drive insert out of body, using punch and hammer.

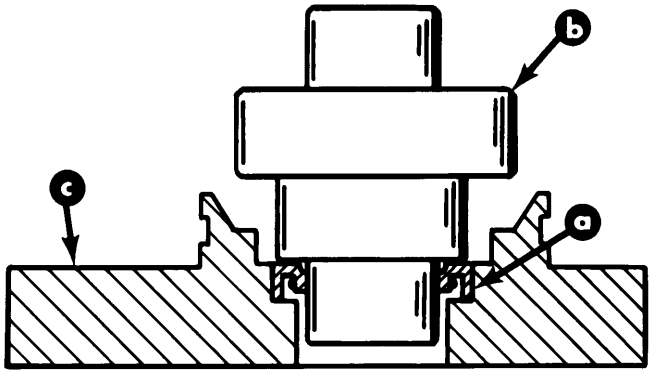


23351

a - 3/16 in. (5 mm) Holes

WATER PUMP REASSEMBLY

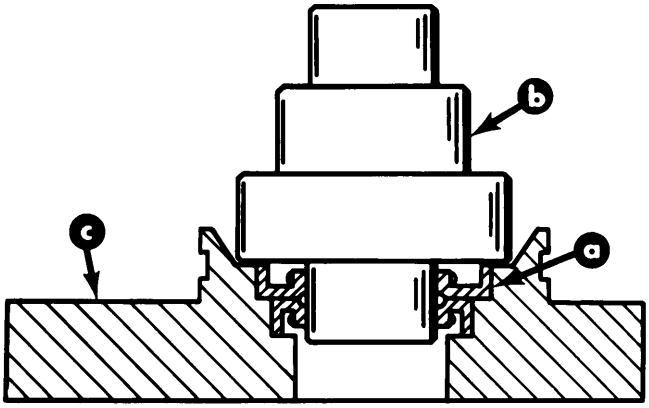
1. Press smaller diameter oil seal into water pump base from bottom, with lip of seal facing top of water pump base using oil seal driver.



23139

a - Oil Seal
b - Oil Seal Driver (91-44110)
c - Water Pump Base

2. Press larger diameter oil seal into water pump base from bottom, with lip of seal facing bottom of water pump base using oil seal driver.



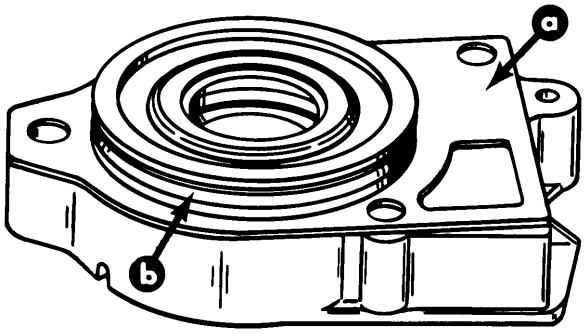
23139

a - Oil Seal
b - Oil Seal Driver (91-44110)
c - Water Pump Base

⚠CAUTION

Water pump base gasket MUST BE installed correctly. A gasket incorrectly installed will block water pump base water passage. A blocked water passage will result in subsequent engine overheating damage.

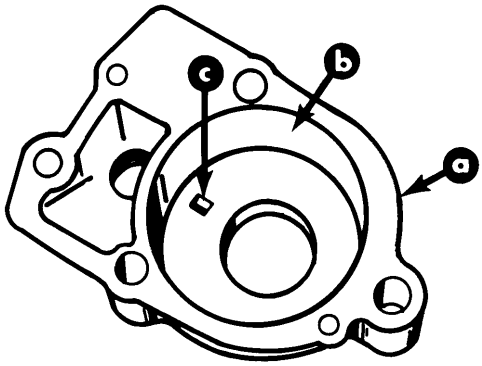
3. Install water pump base gasket and O-ring. Lubricate O-ring with 2-4-C Marine Lubricant.



23343

a - Gasket
b - O-ring

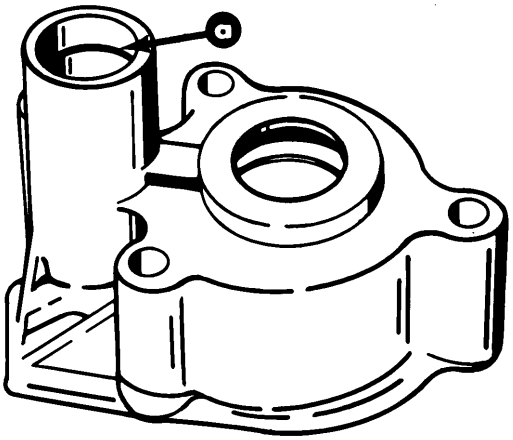
4. Install water pump insert into water pump as follows:
   a. Lubricate water pump insert outside diameter with Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal.
   b. Install insert into water pump body. Make sure that tab on insert enters locating recess in pump body.
   c. Remove all excess lubricant or sealer. DO NOT allow any excess sealer to remain inside insert, or impeller will be damaged.



23351

a - Water Pump Body
b - Insert
c - Tab

5. Install water tube seal. Lubricate inside diameter with 2-4-C Marine Lubricant.



23351

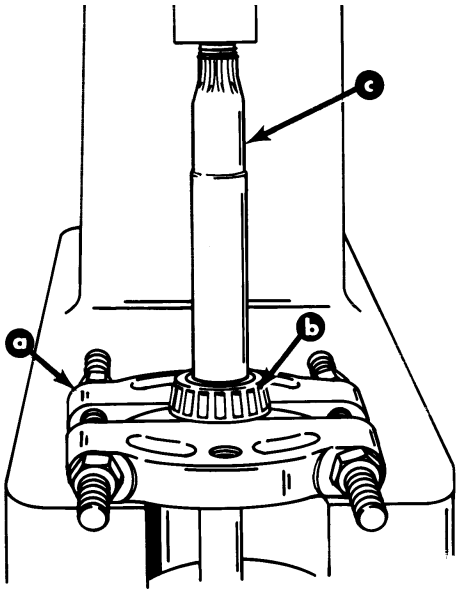
a - Water Tube Seal

DRIVE SHAFT AND PINION BEARING INSPECTION AND CLEANING

1. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.
2. The condition of the bearing surface on drive shaft at needle bearing location gives an indication of the condition of needle bearings. Replace needles and race as a set if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.
3. Inspect splines for worn or twisted condition. Replacement of drive shaft is necessary if either condition exists.
4. Inspect pinion gear for pitting, chipped or broken teeth, fractures and excessive or uneven wear.
5. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

DRIVE SHAFT DISASSEMBLY

1. Press tapered roller bearing from drive shaft using universal puller plate to support bearing (inner race).



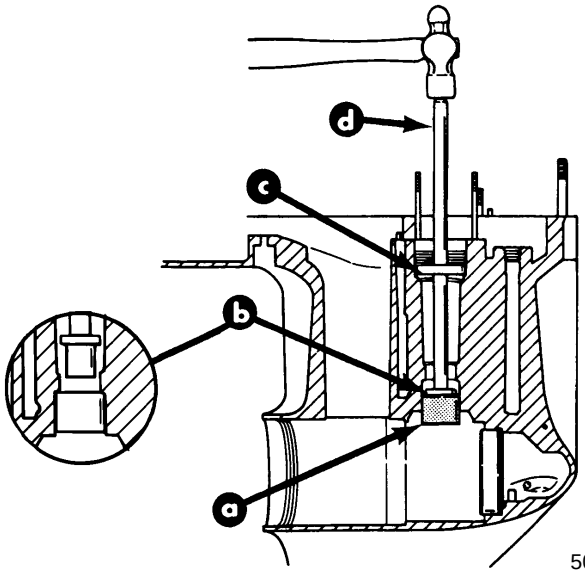
50456

a - Universal Puller Plate 91-37241
b - Drive Shaft Tapered Bearing
c - Drive Shaft

PINION BEARING REMOVAL

IMPORTANT: All needle bearings (18) MUST BE in place inside bearing race while driving pinion bearing from gear housing.

1. Remove pinion bearing using tools as shown.

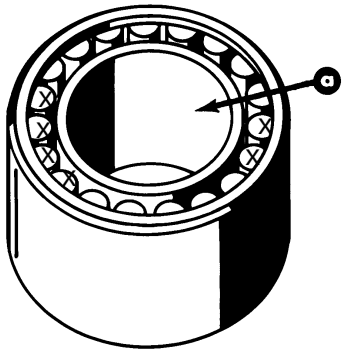


50317

a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

PINION BEARING INSTALLATION

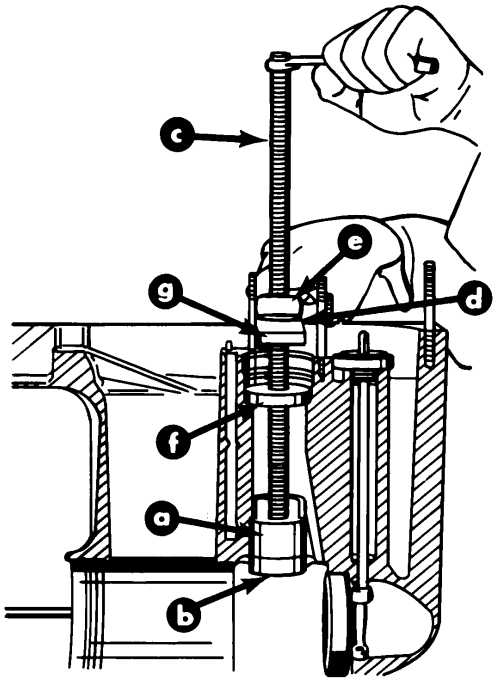
1. If needle bearings have fallen over in casing, install needles using Needle Bearing Assembly Lubricant (92-825265A1) to help hold needles in place. If new bearing is installed, leave cardboard shipping sleeve in place until installed and ready to install drive shaft.



23351

a - Shipping Sleeve

2. Position bearing assembly over bearing installation tool, with lettered and numbered side up.
3. Place bearing into drive shaft bore through prop shaft cavity.
4. Install bearing using tools as shown. Pull bearing up until it bottoms on shoulder inside bore.

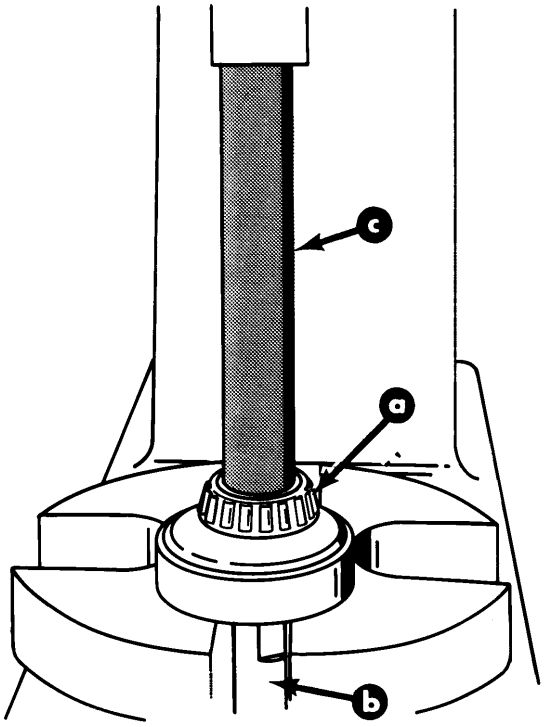


23350

a - Drive Shaft Pinion Bearing
b - Bearing Installation Tool (91-38628)
c - Puller Rod (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Plate (91-29310)

DRIVE SHAFT REASSEMBLY

1. Press tapered drive shaft roller bearing onto drive shaft.

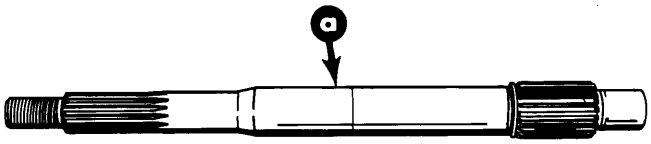


50455

a - Bearing
b - Drive Shaft
c - Drive Shaft Tapered Bearing Driver 91-87119

BEARING CARRIER, REVERSE GEAR AND RETAINER INSPECTION

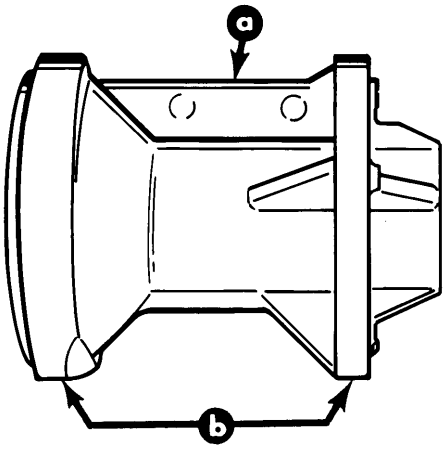
1. The condition of the propeller shaft bearing surface in the area of propeller shaft needle bearing is an indication of the condition of propeller shaft needle bearing. Replace bearing if surface is pitted, grooved, worn uneven, discolored from overheating or has embedded metal particles.



23355

a - Propeller Shaft Bearing Contact Area

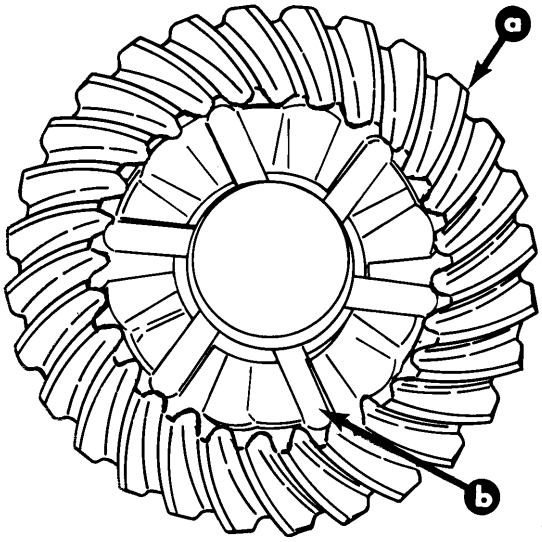
2. Check bearing carrier for signs of corrosion, especially in area where bearing carrier mates with gear housing. If corrosion is evident, replace carrier.



50314

a - Bearing Carrier
b - Mating Surfaces

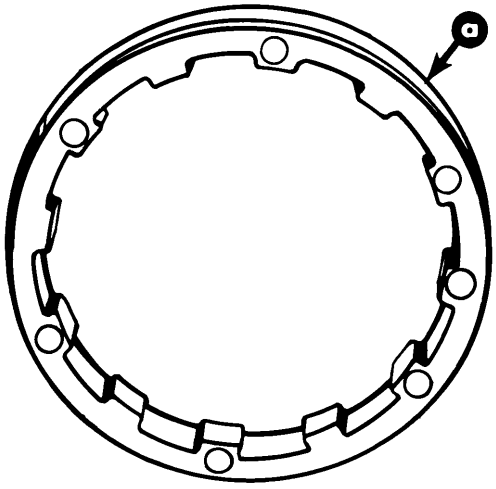
3. Inspect reverse gear for pitting, chipped or broken teeth, hairline fractures or excessive or uneven wear.
4. Inspect clutch jaws for damage. Surface must not be chipped or rounded off.



50454

a - Reverse Gear Teeth
b - Clutch Jaws

5. Check reverse gear bearing for excess movement or roughness when rotating.
6. Inspect bearing carrier retainer for cracks and/or broken or corroded threads.

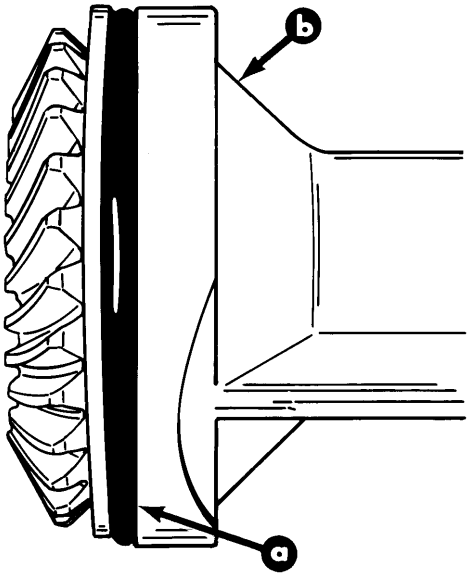


23356

a - Bearing Carrier Retainer

BEARING CARRIER AND REVERSE GEAR DISASSEMBLY

1. Remove O-ring from bearing carrier.



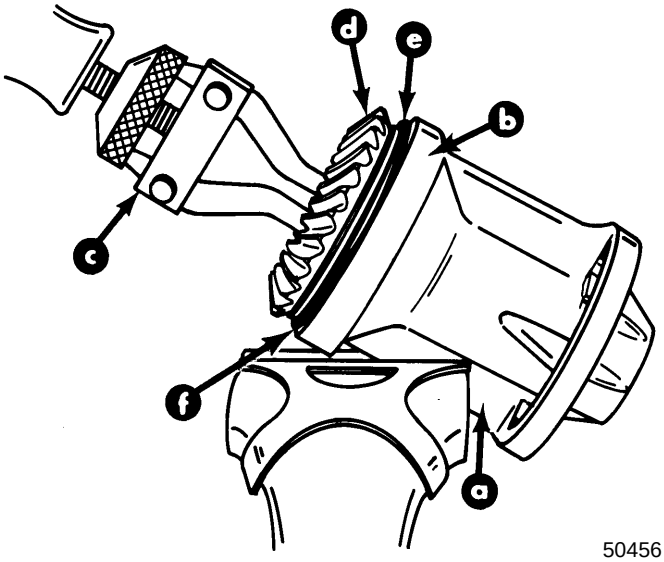
50455

a - O-ring
b - Bearing Carrier

⚠CAUTION

Clamp on reinforcing rib of bearing carrier ONLY, or damage to carrier may result.

2. Place bearing carrier in vise, clamping on carrier reinforcing rib.
3. Using Slide Hammer Puller 91-34569A1, remove, as an assembly, reverse gear, thrust ring and bearing (located inside carrier).

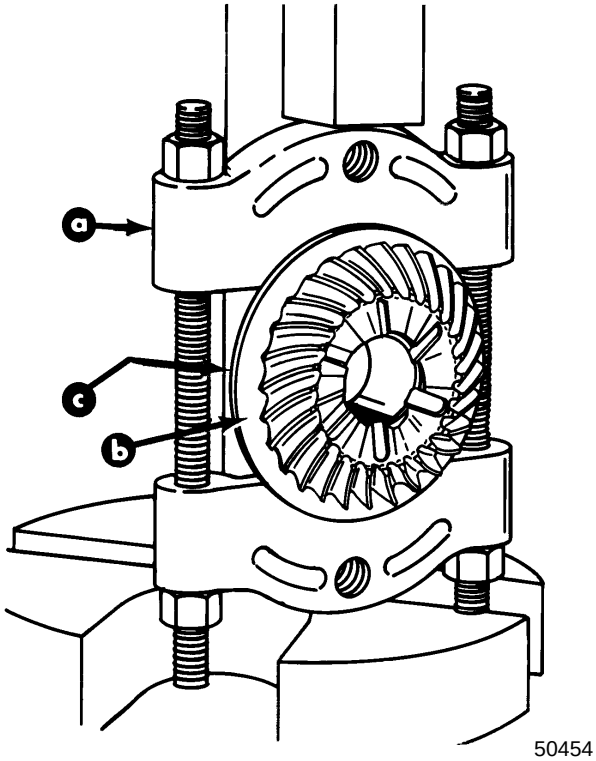


50456

a - Bearing Carrier Reinforcing Rib
b - Bearing Carrier
c - Slide Hammer Puller 91-34569A1
d - Reverse Gear
e - Thrust Ring
f - Bearing (Not Seen) - Located In Carrier

IMPORTANT: Bearing MUST BE replaced if removed from gear.

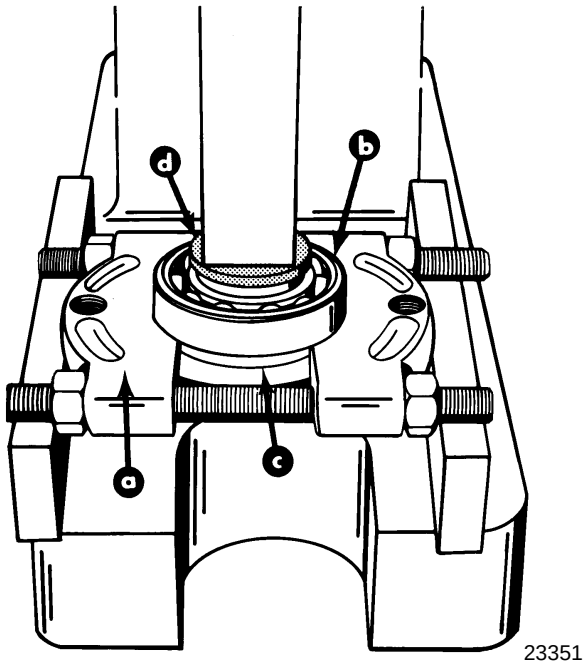
4. Place universal puller plate between thrust washer and bearing as shown.
5. Press on plate until it bottoms.



50454

a - Universal Puller Plate (91-37241)
b - Thrust Washer
c - Bearing

6. Press bearing from reverse gear using universal puller plate to support bearing and pushing on gear with a suitable mandrel.

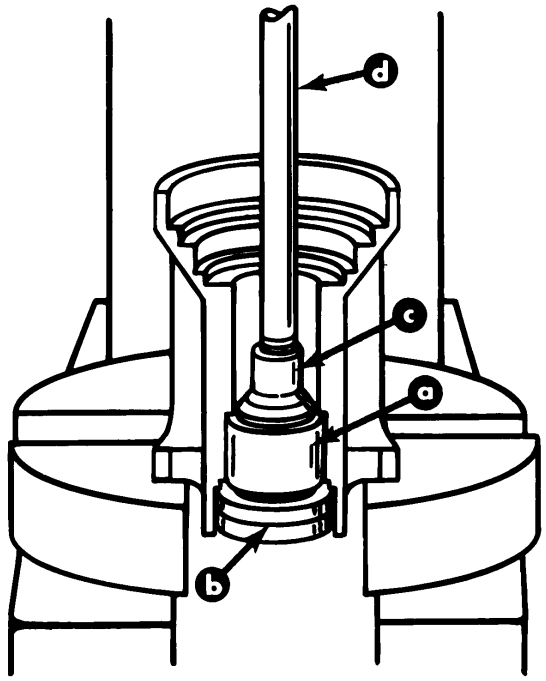


23351

a - Universal Puller Plate (91-37241)
b - Bearing
c - Gear
d - Suitable Mandrel

7. Perform step “a” or “b” as necessary.

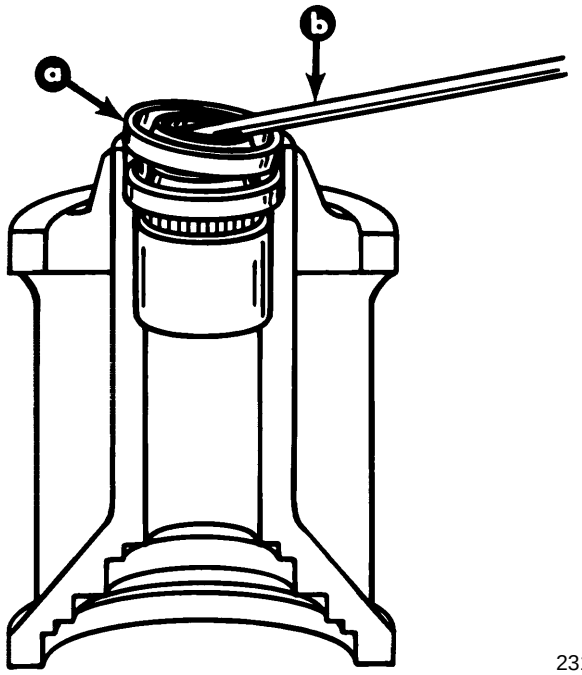
   a. **If Replacing Propeller Shaft Needle Bearing and Seals:** Remove needle bearing and seals with tools as shown.



23140

a - Needle Bearing
b - Oil Seals
c - Puller Head (91-36569)
d - Bearing Driver Rod (91-37323)

   b. **If Replacing Seals Only:** Remove oil seals. Be careful not to damage bore.

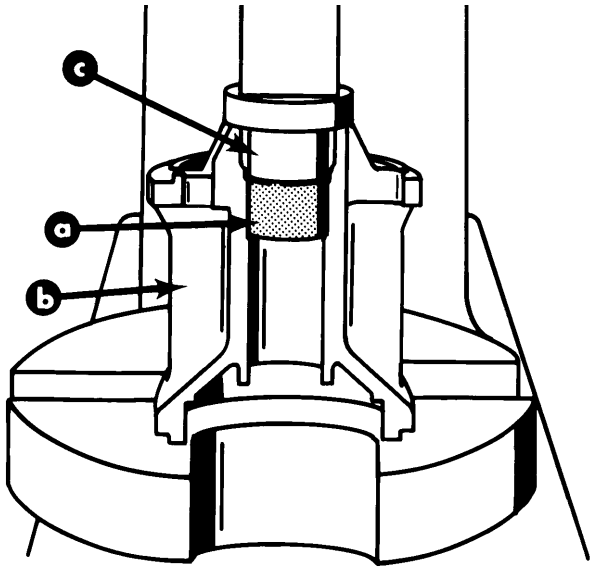


23140

a - Oil Seals
b - Pry Bar

BEARING CARRIER AND REVERSE GEAR REASSEMBLY

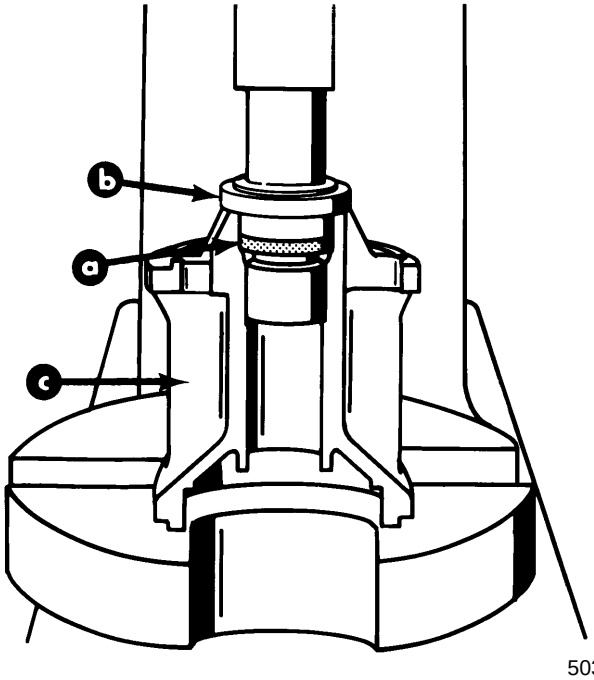
1. Press needle bearing into bearing carrier until tool bottoms on bearing carrier. Ensure numbered side of needle bearing faces seal end of carrier.



50315

a - Needle Bearing
b - Bearing Carrier
c - Bearing Driver (91-15755)

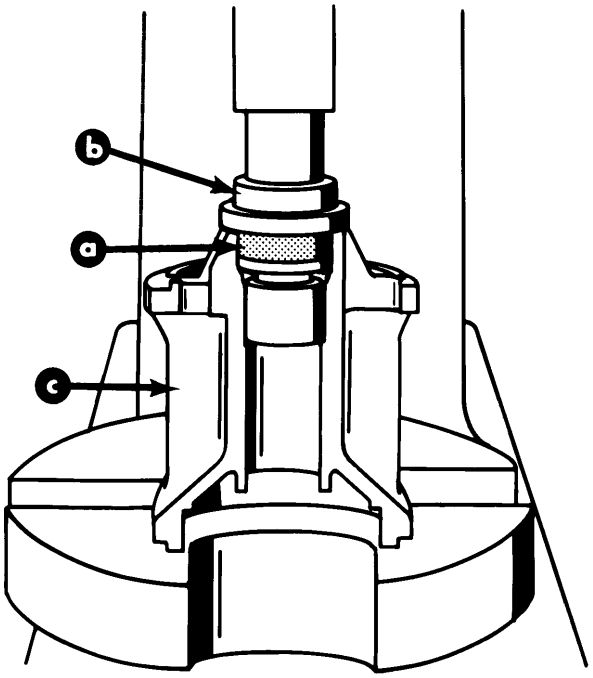
2. Apply Loctite 27131 or Type “A” to outside diameter of first propeller shaft oil seal. Install seal with lip facing needle bearing. Press oil seal with tool until tool bottoms on bearing carrier.



50315

a - Oil Seal
b - Oil Seal Driver (91-31108)
c - Bearing Carrier

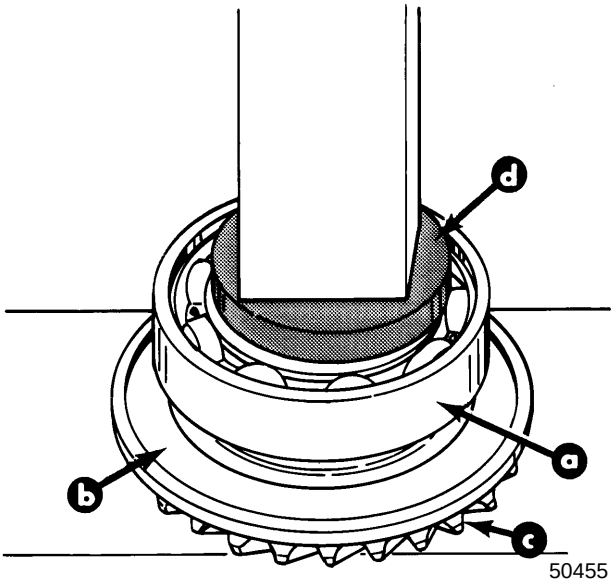
3. Apply Loctite 27131 or Type “A” to outside diameter of second propeller shaft oil seal. Install seal with lip facing away from needle bearing. Press oil seal with tool until tool bottoms on bearing carrier.



50315

a - Oil Seal
b - Oil Seal Driver (91-31108)
c - Bearing Carrier

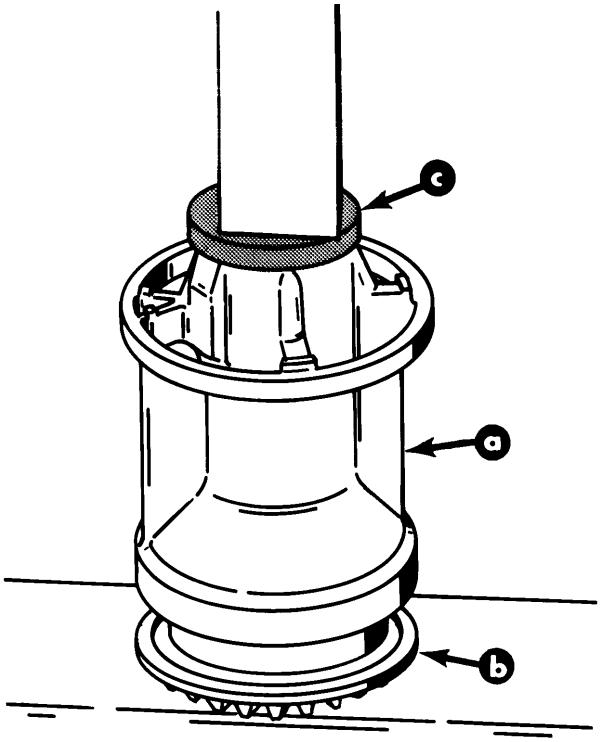
4. Install thrust washer and ball bearing on reverse gear. Press ball bearing using pilot washer until bearing bottoms on gear. install the thrust washer so that the tapered end of the thrust washer faces toward the gear.



50455

a - Ball Bearing
b - Thrust Washer
c - Reverse Gear
d - Pilot Washer (91-36571)

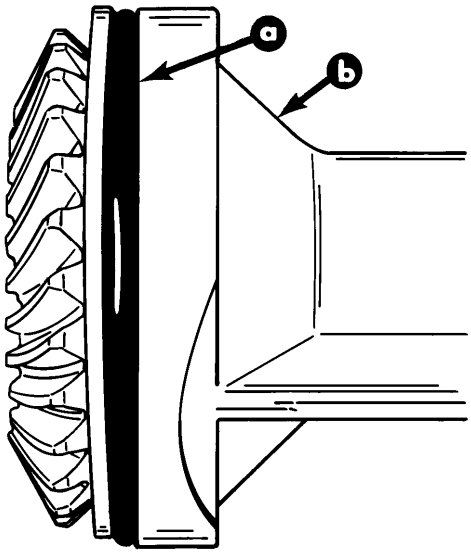
5. Press bearing carrier onto reverse gear and bearing assembly.



50454

a - Bearing Carrier
b - Reverse Gear And Bearing Assembly
c - Pilot Washer 91-36571

6. Install O-ring on bearing carrier.

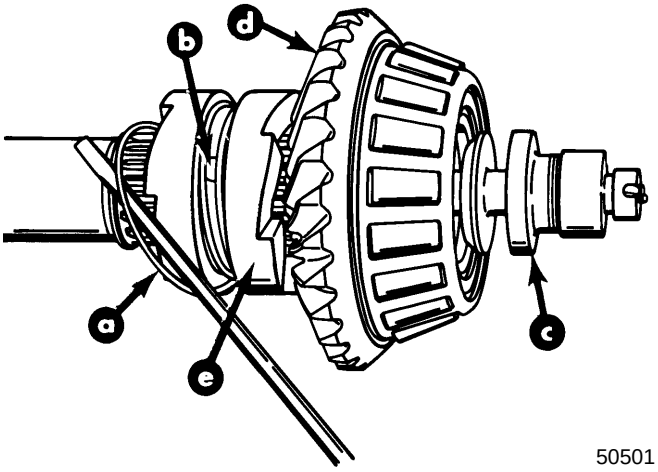


50455

a - O-ring
b - Bearing Carrier

PROPELLER SHAFT, FORWARD GEAR AND SHIFT SPOOL DISASSEMBLY

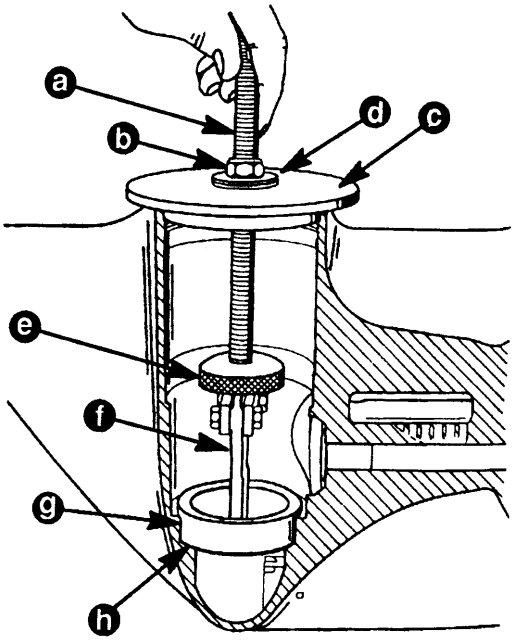
1. Remove components as shown.



50501

a - Spring
b - Pin
c - Shift Spool Assembly
d - Forward Gear Assembly
e - Sliding Clutch

2. Remove forward gear bearing cup and shims. Discard shims. (Measure shim thickness before discarding).



74008

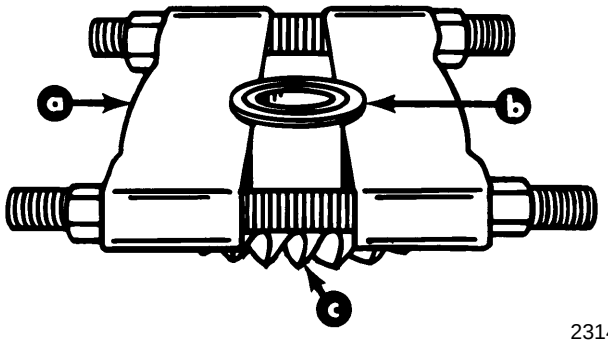
a - Puller Shaft (91-31229)
b - Nut (11-24156)
c - Guide Plate (91-816243)
d - Washer (91-34961)
e - Puller Head (From Slide Hammer Puller 91-34589A1)
f - Jaws (From Slide Hammer Puller 91-34589A1)
g - Bearing Adaptor
h - Shims (Measure And Discard)

NOTE: *The condition of the forward gear tapered roller bearing cup is an indication of the condition of the tapered roller bearing. Replace bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.*

3. Remove tapered roller bearing from forward gear as follows:
   a. Cut off roller bearing cage; remove rollers.

NOTE: *It may be necessary to grind a groove at top lip of bearing race to securely hold universal puller plate in position.*

   b. Press gear from bearing race, using a suitable mandrel.

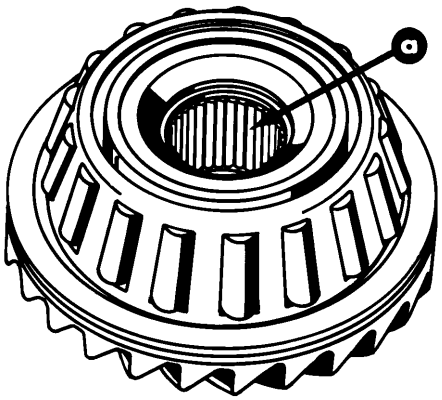


23141

a - Universal Puller Plate (91-37241)
b - Inner Bearing Race
c - Forward Gear

NOTE: *Forward gear needle bearing case is made of a very high tensile steel. Removal of bearing by conventional methods (e.g. - chisel and hammer or mandrel and press) may be very difficult. A notch in the casing may be made with the use of a high speed grinder.*

4. Remove forward gear needle bearing.

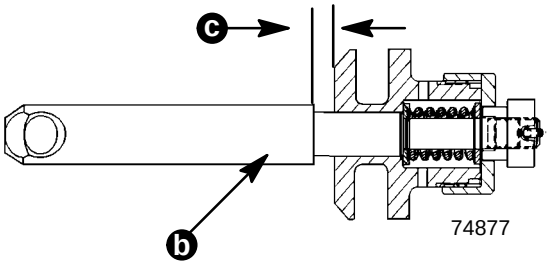


23352

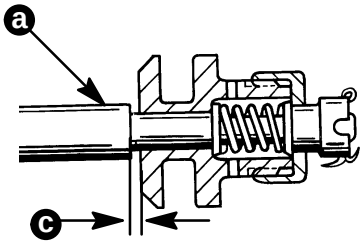
a - Forward Gear Needle Bearing

SHIFT SPOOL ASSEMBLY INSPECTION

NOTE: *The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool is sold as a whole assembly and can be used when replacing the earlier style (Prior to S/N OK041000). The end play for the spool will remain the same as the earlier models [.002-.010 in. (0.05-.25 mm)].*



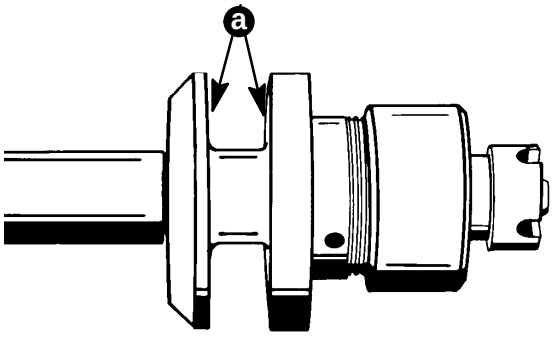
74877



75219

a - Earlier Style Shift Spool Assembly
b - Later Style Shift Spool Assembly
c - Measure End Play Here At Gap

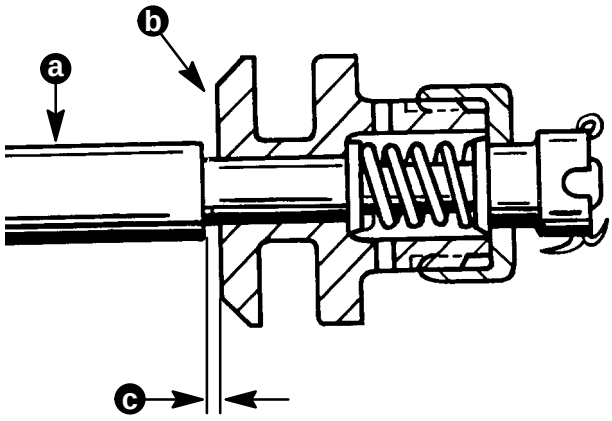
1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.
2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
3. Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

a - Contact Area

4. Ensure that the spool spins freely. It may be helpful to lightly tap the castle nut end of the shift shaft against a firm surface to align the internal parts.
5. Remove the cotter pin and hand tighten end cap until it stops. At this point the shift spool will not turn freely on the shift shaft. Ensure that the spool has .002-.010 in. (.05-.25 mm) end play.

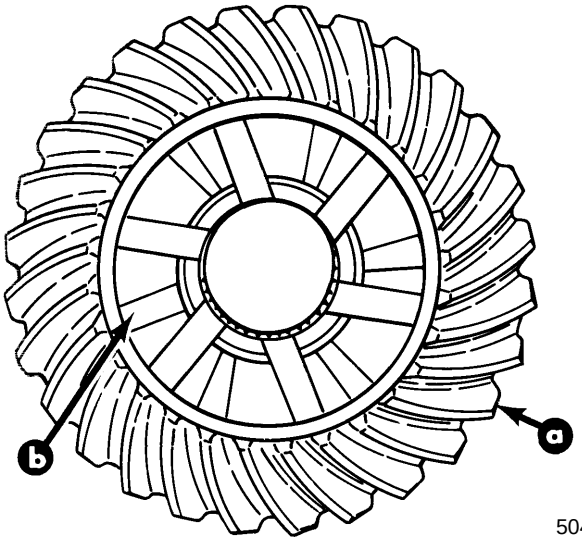


74877

a - Shift Shaft
b - Spool
c - Gap Has Increased-End Play Measurement: .002-.010 in. (0.05-0.25 mm) Is Same As Earlier Models

PROPELLER SHAFT, FORWARD GEAR AND BEARING AND SHIFT SPOOL ASSEMBLY INSPECTION AND CLEANING

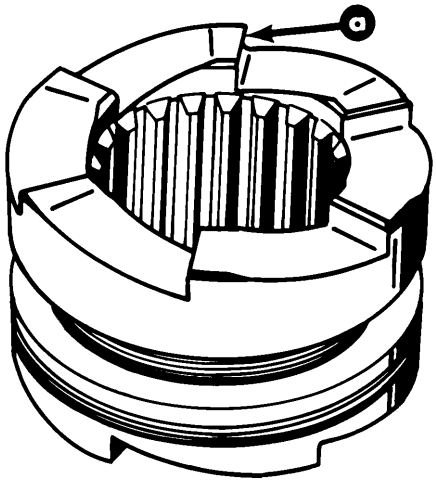
1. Inspect forward gear for pitting, chipped or broken teeth, fracturing and excessive or uneven wear.
2. Check forward gear clutch jaws for damage. Jaws must not be chipped or rounded off.



50454

a - Forward Gear Teeth
b - Clutch Jaws

3. Check sliding clutch engaging jaws for damage. Jaws must not be chipped or rounded off.



23350

a - Sliding Clutch Engaging Jaws

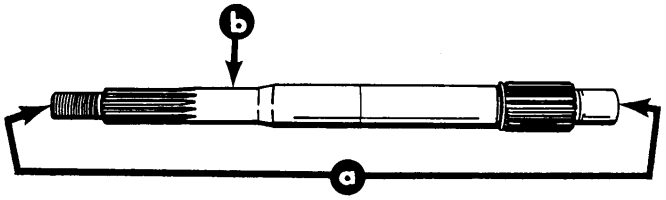
4. Check propeller shaft for bent condition. Use either method following:

Lathe and Dial Indicator

a. Position propeller shaft centers in lathe.

b. Mount dial indicator just forward of propeller shaft splines.

c. Rotate shaft and observe dial indicator movement. Movement of more than .005 in. (0.013 mm) is reason for replacement.



23355

V-Blocks and Dial Indicator

a - Propeller Shaft Centers
b - Mount Dial Indicator Here

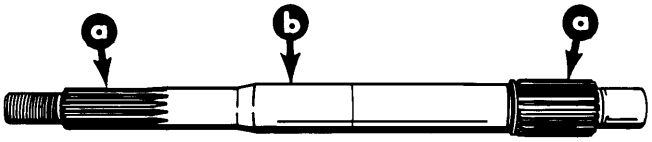
NOTE: *Be sure to adjust V-blocks to compensate for propeller shaft bearing surface diameters.*

a. Position propeller shaft bearing surfaces on V-blocks.

b. Mount dial indicator just forward of propeller shaft splines.

c. Rotate shaft and observe dial indicator movement. Movement of more than .005 in. (0.013 mm) is reason for replacement.

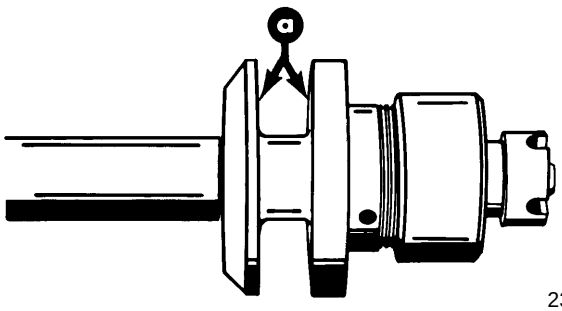
5. Inspect propeller shaft for broken or twisted splines.
6. Inspect surface of propeller shaft where bearing carrier oil seals lips contact shaft. If oil seals have made grooves, propeller shaft must be replaced.



23355

a - Propeller Shaft Splines
b - Oil Seal Contact Area

7. Check shift spool for wear in area where shift crank comes in contact.



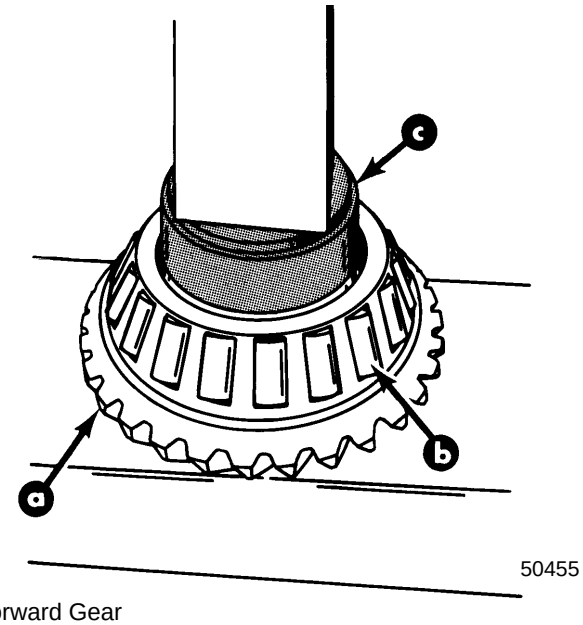
23356

a - Contact Area

8. Clean all component parts (except new bearings) with cleaning solvent. Dry components thoroughly with compressed air, being careful not to spin bearings.

PROPELLER SHAFT AND FORWARD GEAR REASSEMBLY

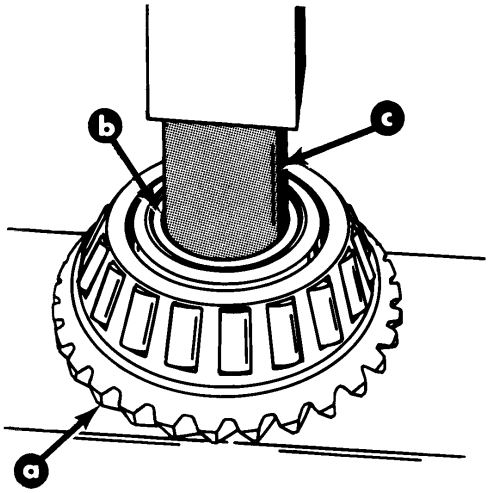
1. Using a suitable mandrel, press tapered roller bearing onto forward gear by pressing on inner bearing race, until bearing bottoms on gear.



50455

a - Forward Gear
b - Tapered Roller Bearing
c - Suitable Mandrel (91-36571 Shown)

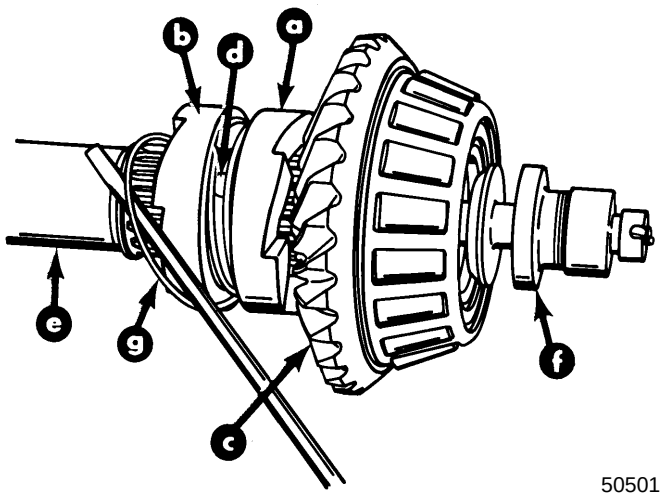
2. Press needle bearing into forward gear with lettered side up - away from gear teeth. DO NOT use excessive force.



50455

a - Forward Gear
b - Needle Bearing - Lettered Side Up-Away From Gear Teeth
c - Needle Bearing Driver 91-33491

3. Assemble propeller shaft, forward gear and shift assembly as follows:
   a. Install sliding clutch on propeller shaft, being sure to align cross pin holes in clutch with slot in propeller shaft. Make sure sliding clutch is placed on propeller shaft with grooved end of clutch facing propeller end of shaft.
   b. Install forward gear and bearing assembly.
   c. Install spool and actuating shaft assembly.
   d. Install cross pin through sliding clutch, propeller shaft and actuating shaft.
   e. Being careful not to distort cross pin retainer spring, install spring to cover cross pin hole.

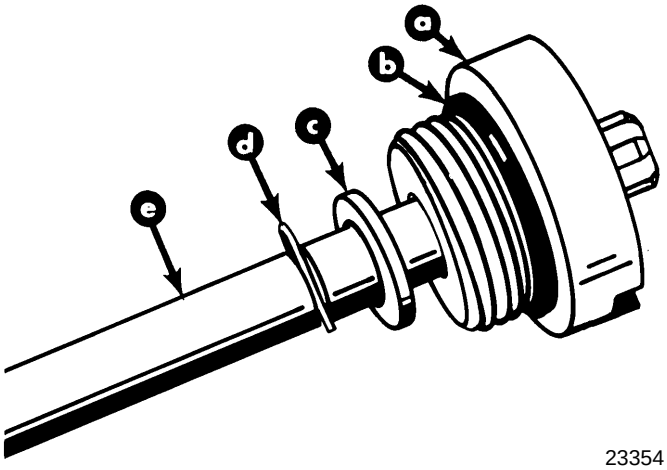


50501

a - Sliding Clutch
b - Groove In Clutch
c - Forward Gear Assembly
d - Cross Pin
e - Propeller Shaft
f - Spool And Actuating Shaft Assembly
g - Cross Pin Retainer Spring

SHIFT SHAFT DISASSEMBLY

1. Remove shift shaft components as shown.

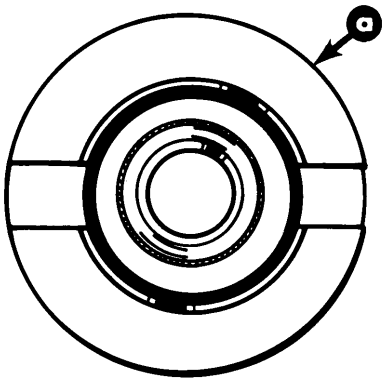


23354

a - Shift Shaft Bushing
b - O-ring
c - Washer
d - Clip
e - Shift Shaft

SHIFT SHAFT INSPECTION AND CLEANING

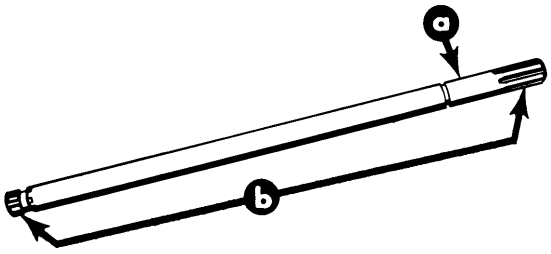
1. Inspect shift shaft bushing for corrosion.



23349

a - Shift Shaft Bushing

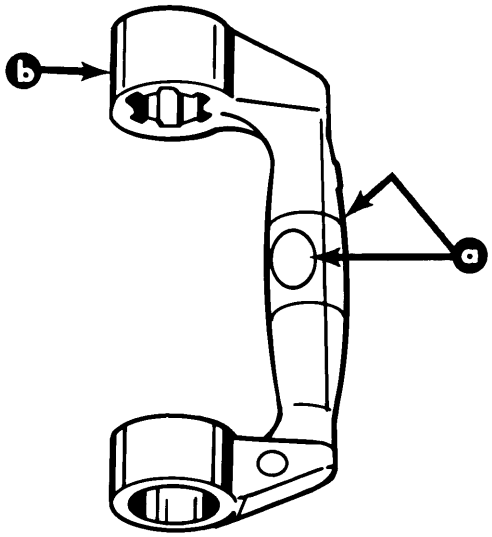
2. Inspect shift shaft splines and seal surface for corrosion. Ensure splines are not twisted.



23355

a - Seal Surface
b - Splines

3. Inspect shift crank for wear in area that contacts shift spool.



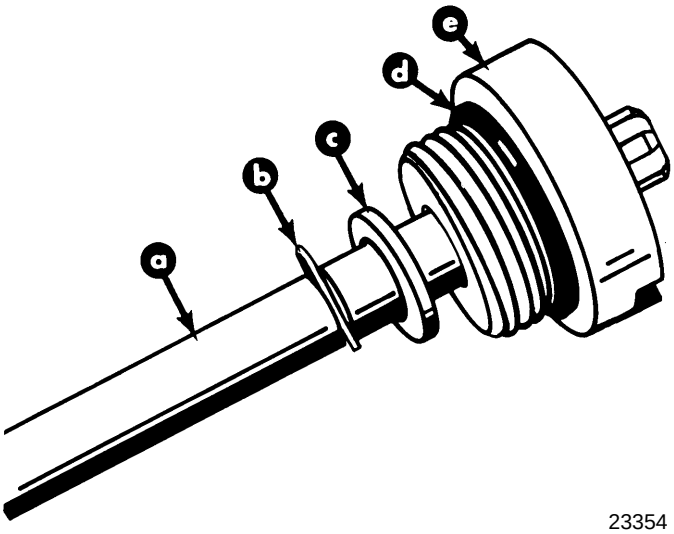
23350

a - Contact Area
b - Shift Crank

SHIFT SHAFT REASSEMBLY

NOTE: *If oil seal in shift shaft bushing is found to be defective, oil seal and shift shaft bushing must be replaced as an assembly.*

1. Reassemble shift shaft components in order shown.



23354

a - Shift Shaft
b - Clip
c - Washer
d - O-ring
e - Shift Shaft Bushing (Seal Inside)

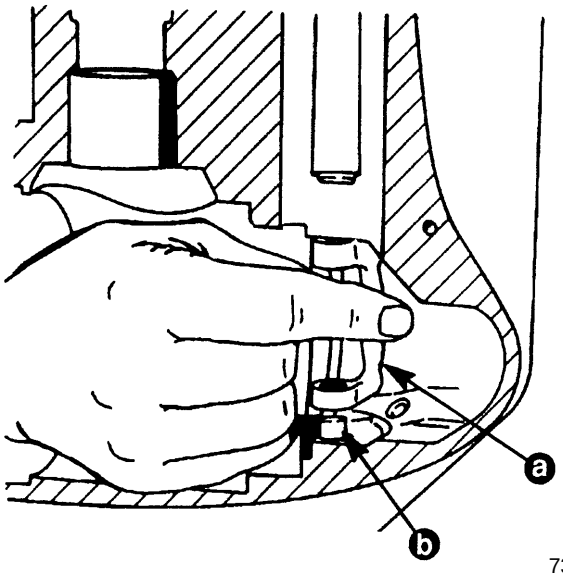
GEAR HOUSING CLEANING AND INSPECTION

1. Check gear housing carefully for impact damage.
2. Inspect bearing carrier retainer threads, in gear housing for corrosion or stripped threads. Clean with hard bristle brush.
3. Inspect bearing contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores.
4. Inspect for blockage in water inlet holes. Clean if necessary.
5. Make sure that locating pins are in place in gear housing and that corresponding holes in drive shaft housing are not elongated. Drive shaft may break if housings are not aligned properly.

Gear Housing Reassembly And Shimming

SHIFT SHAFT INSTALLATION

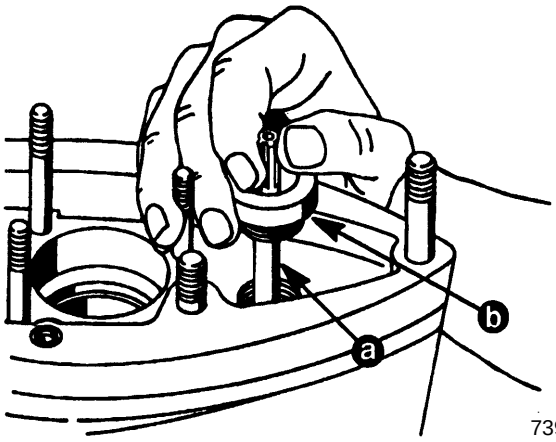
1. Place shift crank on locating pin in forward section of gear housing. Ensure shift crank faces toward left (port) side of gear housing.



73870

a - Shift Crank
b - Locating Pin

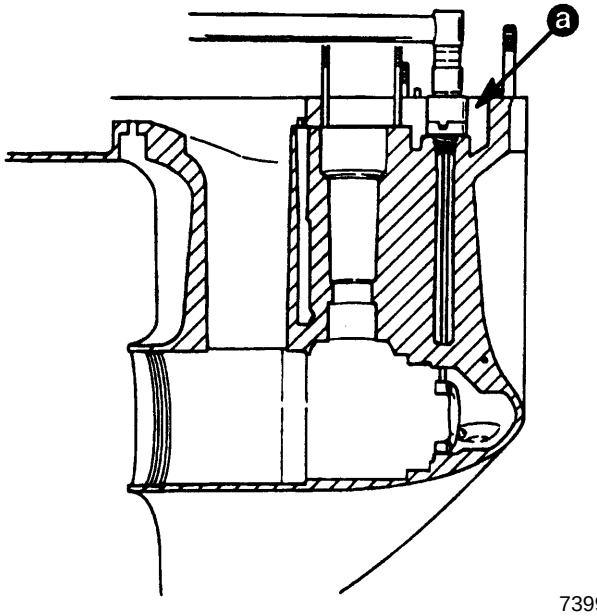
2. Install shift shaft assembly into gear housing as shown. Ensure that lower splined end of shift shaft is engaged with shift crank. Coat threads of shift shaft bushing with Perfect Seal.



73990

a - Shift Shaft Assembly

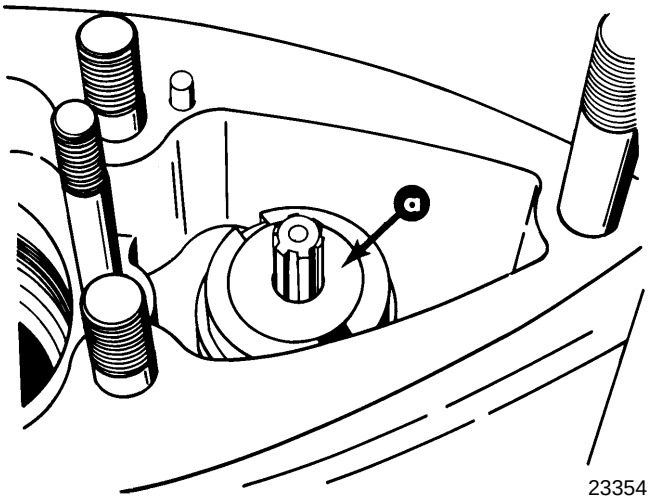
3. Thread shift shaft bushing into gear housing. Torque to 50 lb. ft. (68 N·m) using shift shaft bushing tool.



73991

a - Shift Shaft Bushing Tool (P/N 91-31107)

4. Install rubber washer and then stainless steel washer onto shift shaft.



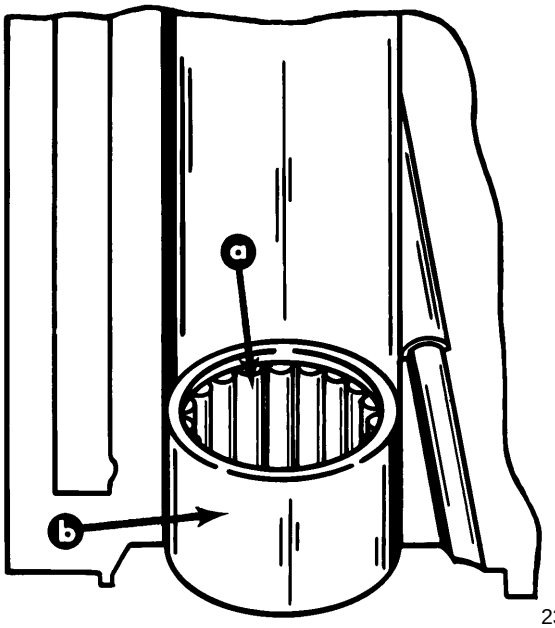
23354

a - Stainless Steel Washer (Rubber Washer Beneath)

DRIVE SHAFT AND PINION GEAR INSTALLATION (Without Propeller Shaft in Place)

IMPORTANT: If unit does not require reshimming (no parts were replaced), proceed to Propeller Shaft and Forward Gear Installation. if pinion height must be checked, proceed as follows.

1. If pinion bearing was not replaced, but needle bearings have fallen out during disassembly, install 18 needles in needle bearing outer race. Use needle bearing assembly lubricant to help hold needles in place.

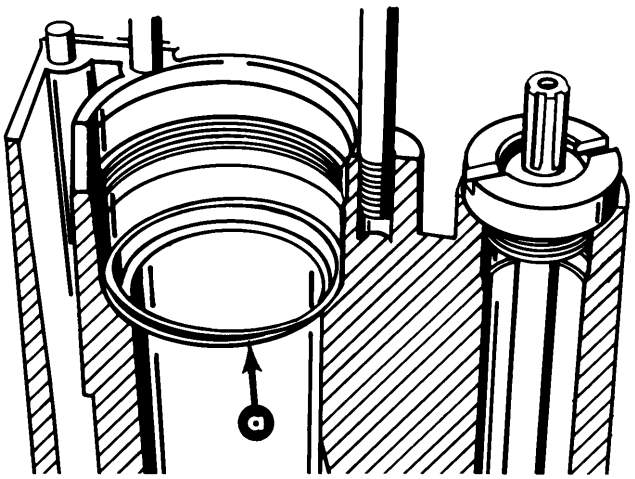


23142

a - Rollers (18)-Hold In Place Using Needle Bearing Assembly Lubricant (P/N 92-825265A1)
b - Roller Bearing Outer Race

NOTE: *If shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing or gear housing were replaced, start off by installing a .015 in. (0.38 mm) shim.*

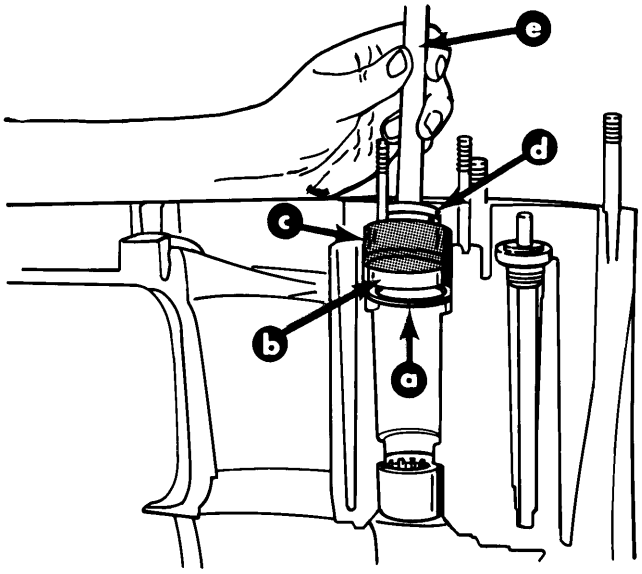
2. Place shim(s) in drive shaft housing bore.



23351

a - Shim(s)

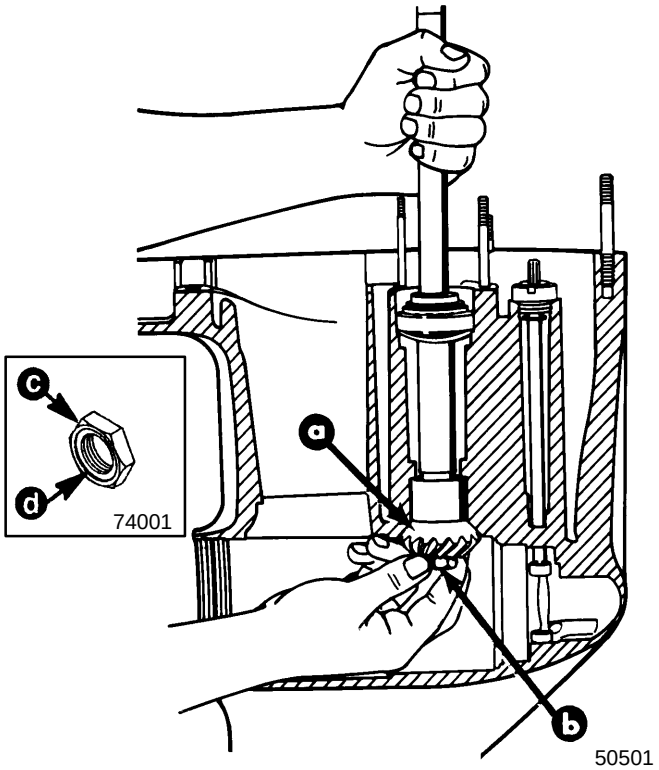
3. Place shim(s) in drive shaft housing bore. Install drive shaft tapered roller bearing cup.



50454

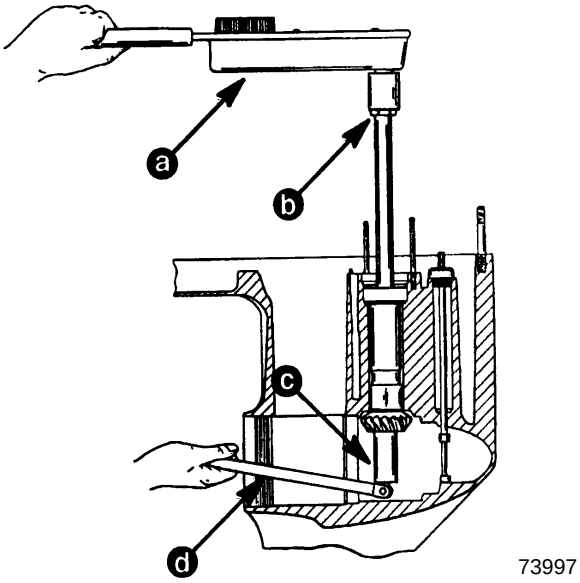
a - Shim(s)
b - Bearing Cup
c - Driver Cup 91-36577
d - Adaptor 91-36569
e - Driver Rod 91-37323

4. Place pinion gear in gear housing.
5. Insert drive shaft in bore. Rotate drive shaft to engage splines in drive shaft. Install pinion nut with the machined shoulder against the pinion gear. If both sides of the nut have a machined shoulder, then either shoulder may be placed against the pinion gear.



a - Pinion Gear
b - Nut
c - Pinion Nut
d - Shoulder

6. Torque pinion nut to 60-80 lb. ft. (81-108 N·m).



a - Drive Shaft Nut Wrench (P/N 91-56775)
b - Torque Wrench
c - Socket
d - Breaker Bar

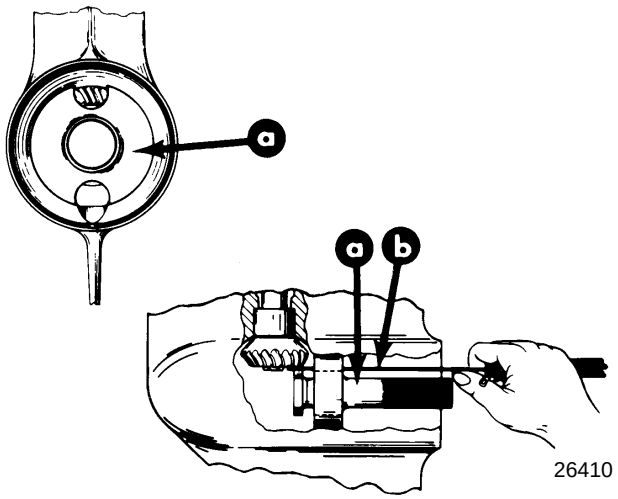
CHECKING PINION GEAR HEIGHT

1. Measure pinion height as follows:
   a. Place pinion gear shimming tool in gear housing.

NOTE: *Take the following measurements at 3 locations, rotating drive shaft and pinion gear 120 degrees at a time.*

   b. Insert a .025 in. (0.64 mm) feeler gauge between one tooth of pinion gear and high point of shimming tool. Take 2 or more readings, rotating drive shaft and pinion gear 120 degrees at a time. Be sure to maintain downward pressure. Clearance should be exactly .025 in. (0.64 mm).

c. If clearance is not correct, add or subtract shims from beneath drive shaft tapered roller bearing cup to obtain proper pinion gear height.



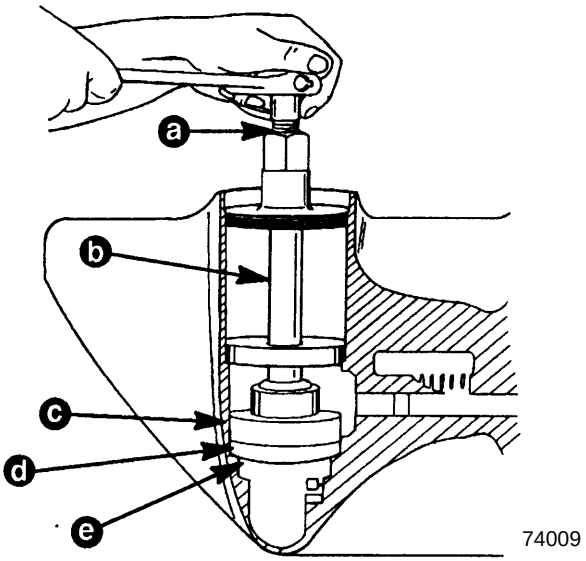
a - Pinion Gear Shimming Tool (91-56048)
b - .025 in. (0.64 mm) Feeler Gauge

2. Remove drive shaft pinion nut and remove pinion and drive shaft.

FORWARD GEAR BEARING CUP INSTALLATION

NOTE: *If installing new shims, start with a .020 in. (.050 mm) shim pack.*

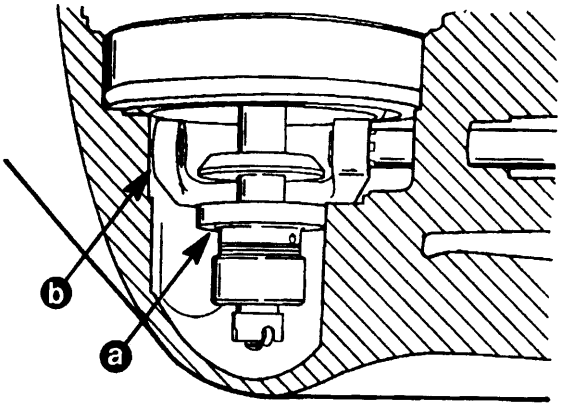
1. Place shims in gear housing.
2. Install the bearing cup with the Bearing Adaptor Installation Tool (91-18605A2). Lubricate hex head screw threads with Quicksilver Special Lubricant 101.



a - Hex-Head Screw
b - Bearing Adaptor Installation Tool (91-18605A2)
c - Driver Cup (91-36577)
d - Bearing Cup
e - Shims

PROPELLER SHAFT, FORWARD GEAR AND SHIFT SPOOL INSTALLATION

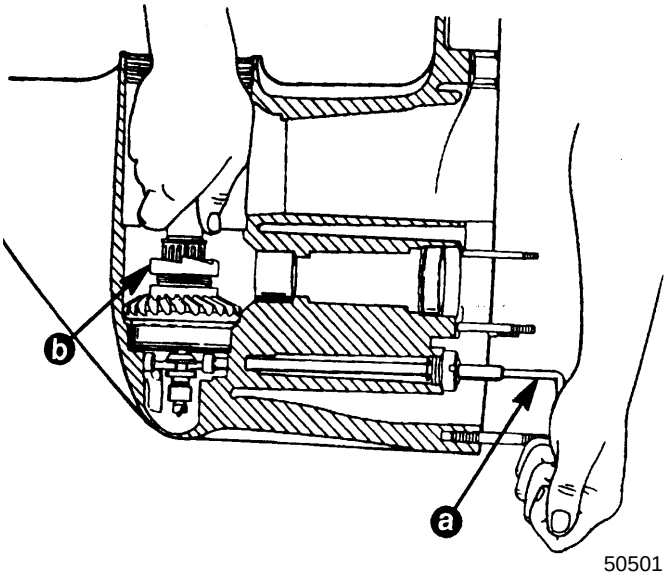
To allow engagement of shift actuating spool with shift crank, install propeller shaft assembly by tilting propeller end of shaft to the left (port) side of gear housing.



50502

a - Shift Actuating Spool
b - Shift Crank

1. Reposition propeller shaft so that it is straight in bore.
2. Operate shift shaft to assure proper installation. Sliding clutch should move up and down on propeller shaft as shift shaft is turned.



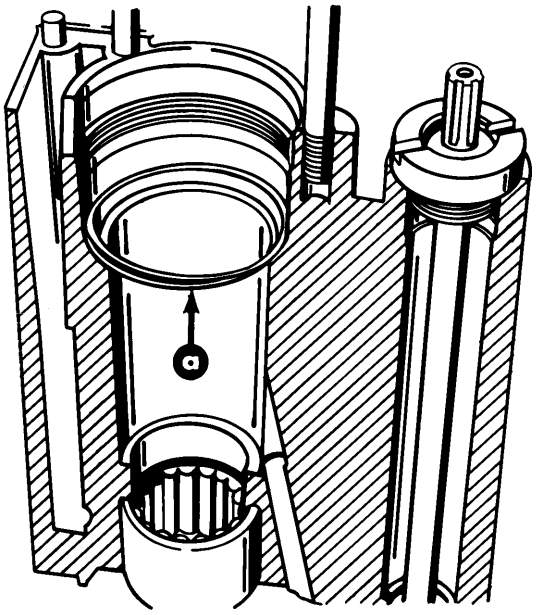
50501

a - Shift Shaft Tool
b - Sliding Clutch

DRIVE SHAFT AND PINION GEAR INSTALLATION (With Propeller Shaft in Place)

NOTE: *On final installation, after all shimming has been checked, apply Loctite 27131 or Type "A" to threads of pinion nut.*

1. Install drive shaft as follows:
   a. Install original shims or shim thickness determined from checking pinion gear height, into drive shaft bore.
   b. Install bearing cup on top of shims.



23351

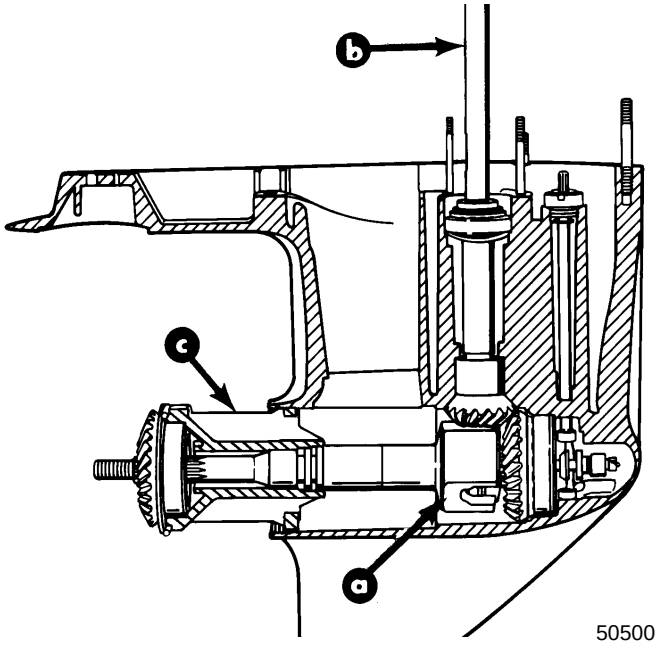
a - Shims

   c. Apply Loctite 27131 (92-809820) to pinion nut threads.
   d. Place pinion nut (with washer glued in place) on pinion nut adaptor.
   e. Install drive shaft and pinion gear. Rotate drive shaft to allow drive shaft splines and pin ion gear splines to engage. DO NOT push pinion gear completely onto drive shaft until pinion nut adaptor (with nut and washer is in place in the following step).

f. Insert pinion nut adaptor (with nut and washer) into gear housing, might need to raise drive shaft to clear rod. Start pinion nut threads on drive shaft by rotating drive shaft.

g. Install pinion nut with the machined shoulder against the pinion gear. If both sides of the nut have a machined shoulder, then either shoulder may be placed against the pinion gear.

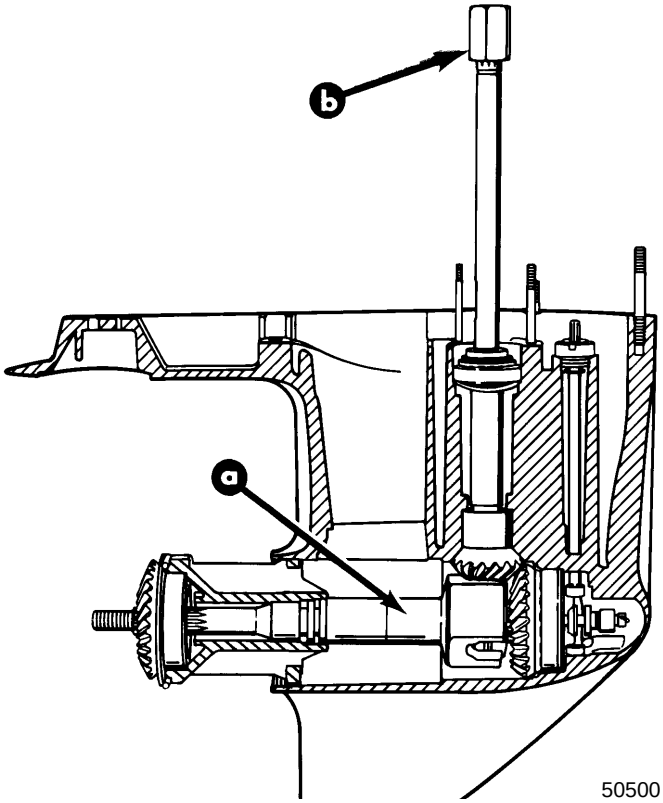
h. Install bearing carrier into gear housing backwards to hold propeller shaft and pinion nut adaptor straight when tightening nut.



50500

a - Pinion Nut Adaptor (91-61 067A3)
b - Drive Shaft
c - Bearing Carrier

i. Torque pinion nut by turning drive shaft using pinion nut wrench and torque wrench with appropriate socket, to 60-80 lb. ft. (81-108 N·m). Push down on the driveshaft while torquing the pinion nut.



50500

a - Pinion Nut Adaptor (P/N 91-61067A2)
b - Drive Shaft Nut Wrench (P/N 91-56775)

j. Remove bearing carrier, pinion nut adaptor and drive shaft nut wrench.

BEARING CARRIER AND REVERSE GEAR INSTALLATION

NOTE: *Perform STEP 1 when reassembling unit for the last time (after checking shimming).*

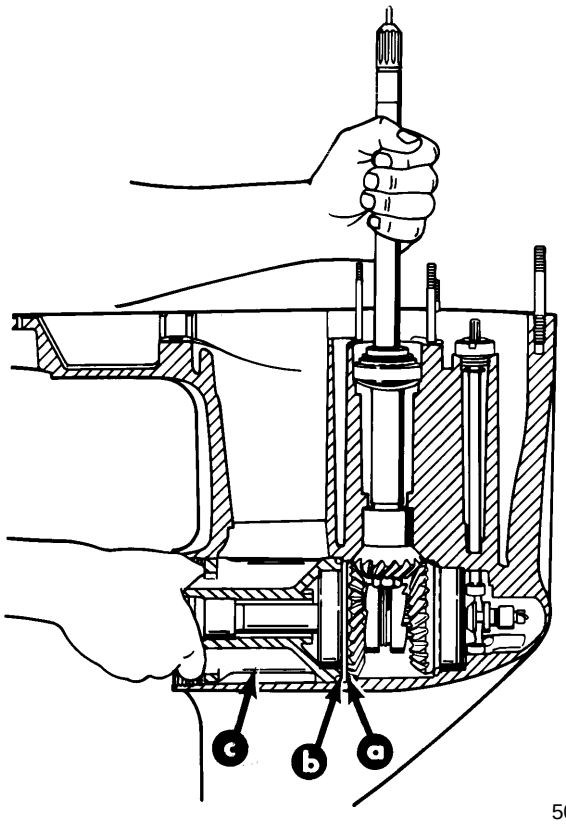
1. Lubricate the following as specified:

   a. Lubricate outer diameter of bearing carrier (including O-ring) with Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal.

   b. Fill space between carrier oil seals with 2-4-C Marine Lubricant.

   c. Lubricate bearing carrier retainer with Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal.

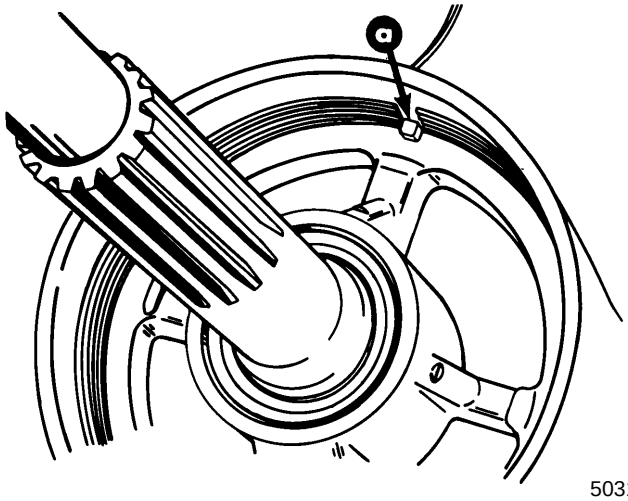
2. Place .053 in. (1.3 mm) shim spacer in gear housing.
3. Place bearing carrier assembly into gear housing. It may be necessary to turn drive shaft to align teeth of pinion and reverse gears.



50500

a - Shim Spacer
b - Shim(s)
c - Bearing Carrier Assembly

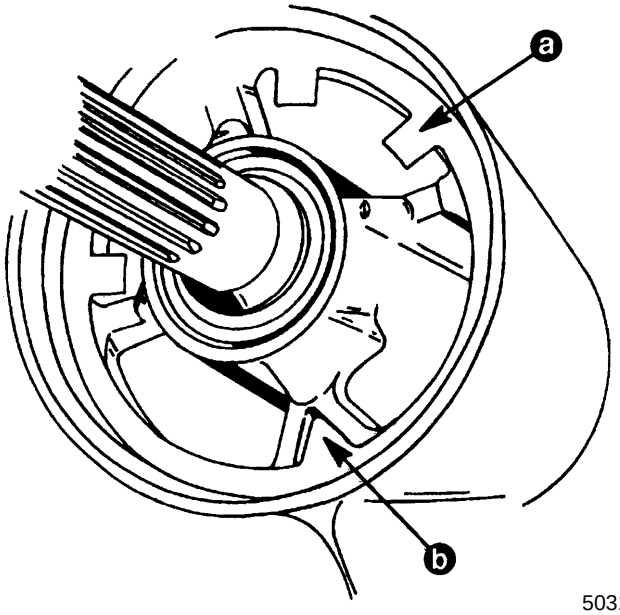
4. Align bearing carrier key slot and key slot in gear housing and install key.



50312

a - Key

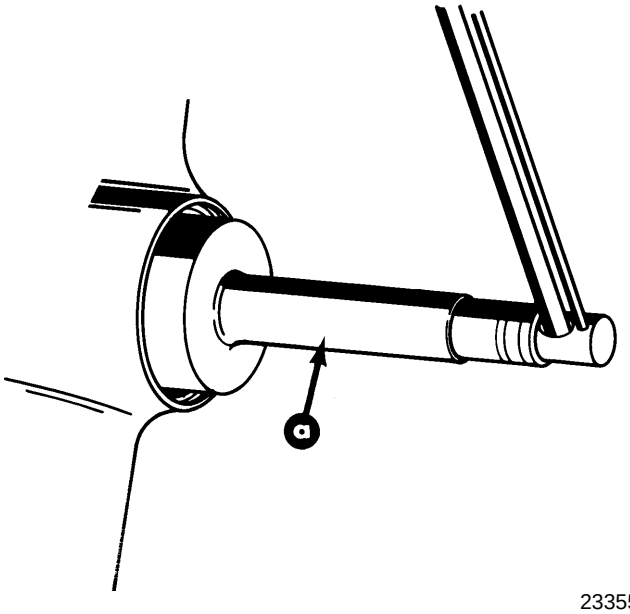
5. Install tab washer. Ensure “V” shaped tab aligns with “V” notch in bearing carrier.



50314

a - Tab Washer
b - “V” Tab

6. Install bearing carrier retainer. Torque to 200 lb. ft. (285 N·m).

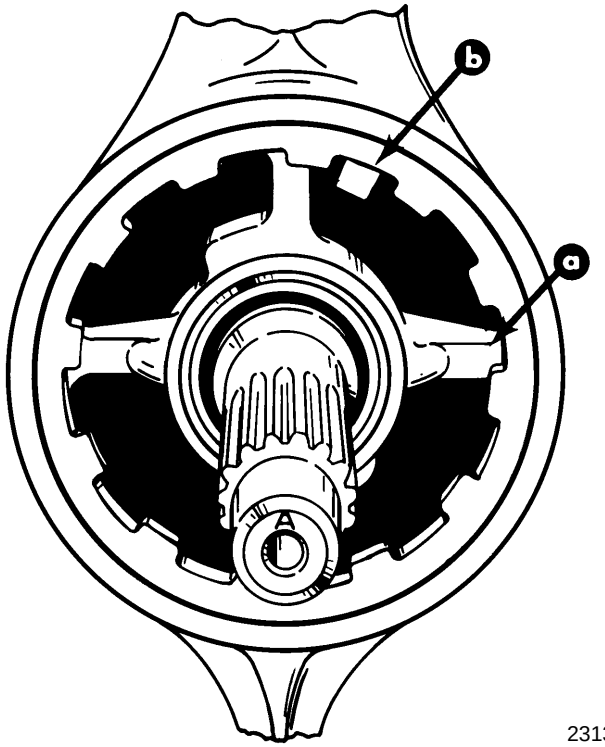


23355

a - Bearing Carrier Retainer Wrench (91-61069)

IMPORTANT: Do not secure bearing carrier retainer by bending tab on tab washer until forward and reverse gear backlash have been checked and corrected as explained following.

7. If backlash is correct, bend three tabs in toward bearing carrier and one tab out into a notch in bearing carrier retainer.

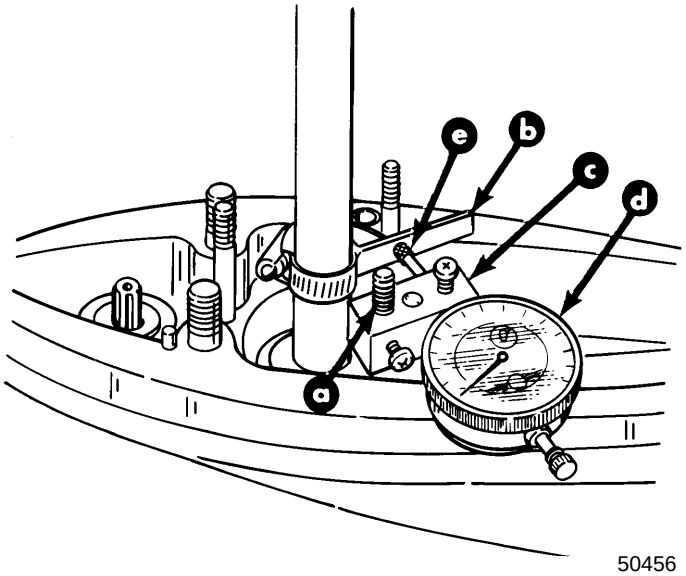


23137

a - Bearing Carrier
b - Tab Washer

CHECKING FORWARD GEAR BACKLASH

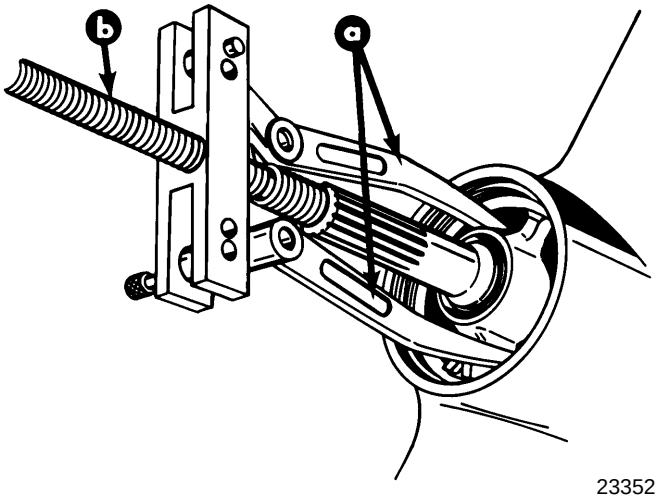
1. Install: Backlash Indicator Rod 91-53459
   Dial Indicator Holding Tool 91-89897
   Dial Indicator 91-58222A1
2. Position dial indicator pointer to line marked “I” on Backlash Indicator Rod.



50456

a - Gear Housing Stud
b - Backlash Indicator Rod 91-53459
c - Dial Indicator Holding Tool 91-89897
d - Dial Indicator-91-58222A1
e - Dial Indicator Pointer

3. Attach Puller Jaws 91-46086A1 and Puller Bolt 91-85716 onto bearing carrier and propeller shaft.
4. Torque bolt to 45 lb. in. (5 N·m).



23352

a - Puller Jaws 91-46086A1
b - Puller Bolt 91-85716

NOTE: *Take the following backlash readings at 4 locations, rotating drive shaft 90° at a time.*

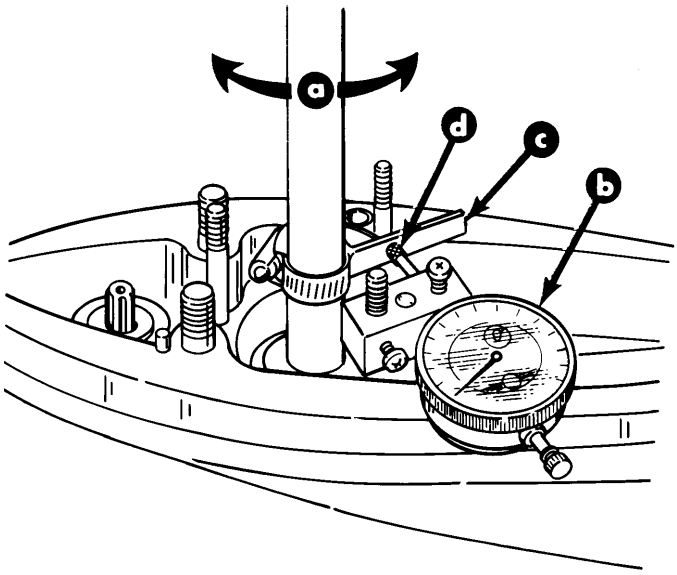
5. Lightly turn drive shaft back-and-forth, so as to feel backlash between gears (no movement should be noticed at propeller shaft).

   Dial indicator MUST register .020-.023 in. (0.51 - 0.58 mm).

   To ensure repeatability of results, take 3 or more backlash readings, turning drive shaft 90° at a time. Be sure to loosen Backlash Indicator Rod to realign dial indicator pointer with "I" mark on rod.

   - **If backlash is less than required,** remove appropriate shim thickness from forward gear bearing race.
   - **If backlash is more than required,** add appropriate thickness shim(s) to forward gear bearing race.

NOTE: *By adding or subtracting .001 in. (0.025 mm) shim, the backlash will change approximately .0008 in. (0.020m m).*

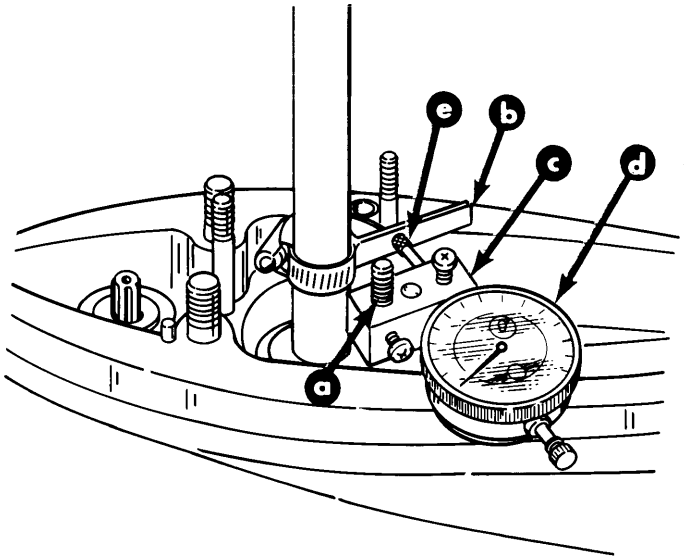


50456

a - Drive Shaft
b - Dial Indicator
c - Indicator Rod
d - Indicator Pointer

CHECKING REVERSE GEAR BACKLASH

1. Install: Backlash Indicator Rod 91-53459
   Dial Indicator Holding Tool 91-89897
   Dial Indicator 91-58222A1
2. Position dial indicator pointer to line marked "I" on backlash Indicator Rod.

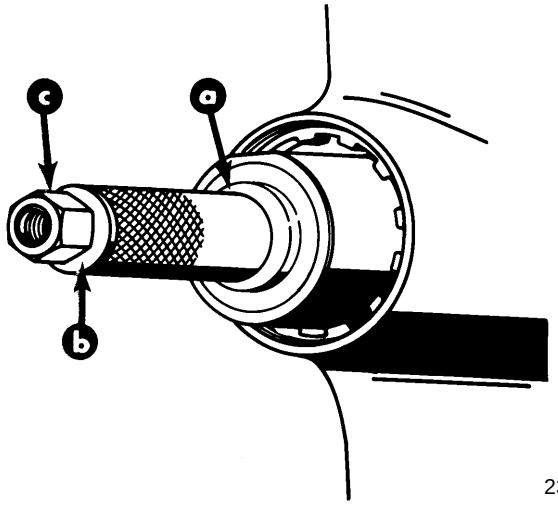


50456

a - Gear Housing Stud
b - Backlash Indicator Rod 91-53459
c - Dial Indicator Holding Tool 91-89897
d - Dial Indicator 91-58222A1
e - Dial Indicator Pointer

NOTE: *It may be necessary to shift gear housing into reverse gear before torquing propeller nut.*

3. Install components shown.
4. Torque propeller nut to 45 lb. in. (5 N·m).



23355

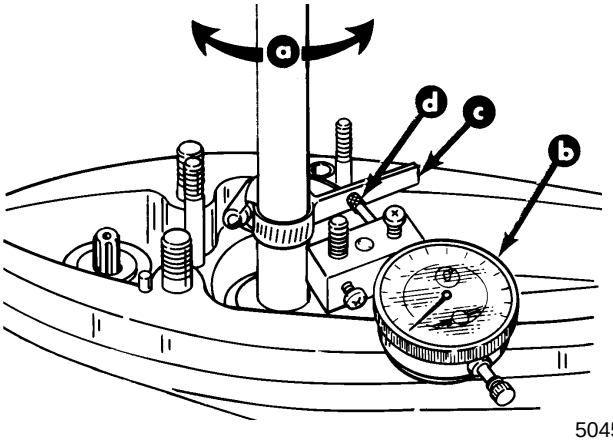
a - Pinion Nut Adaptor 91-61067A2
b - TR Belleville Washer 12-54048-Concave Side Toward Propeller Nut
c - Propeller Nut

5. Lightly turn drive shaft back-and-forth, so as to feel backlash between gears (no movement should be noticed at propeller shaft).

   Dial indicator MUST register .040-.060 in. (1.02-1.52 mm).

   - **If backlash is more than required,** check for improper installation of bearing carrier.
   - **If backlash is less than required,** add appropriate thickness shims (from shim pack 15-31535A1) between gear housing and bearing carrier.

NOTE: *By adding .001 in. (0.025 mm) shim, the backlash will change approximately .0008 in. (0.020 mm).*

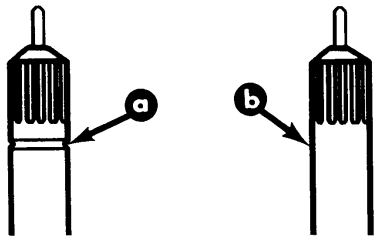


50456

a - Drive Shaft
b - Dial Indicator
c - Indicator Rod
d - Indicator Pointer

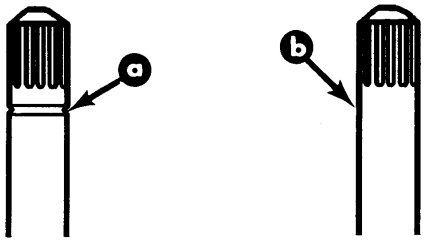
ALPHA I AND MC I DRIVE SHAFT CHANGES

The service drive shaft for the lower unit will no longer have an O-ring groove at the top of the shaft under the splines on all Alpha One 1990 and prior and also MC I through 1976. All present production units contain the New Style shaft without an O-ring groove also.



71185

a - MC I Old Style (With O-ring Groove)
b - MC I New Style (Without O-ring Groove)

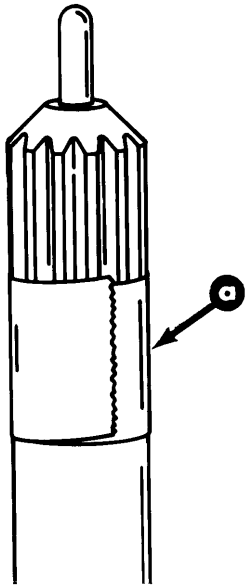


71185

a - Alpha One Old Style (With O-ring Groove)
b - MC I New Style (Without O-ring Groove)

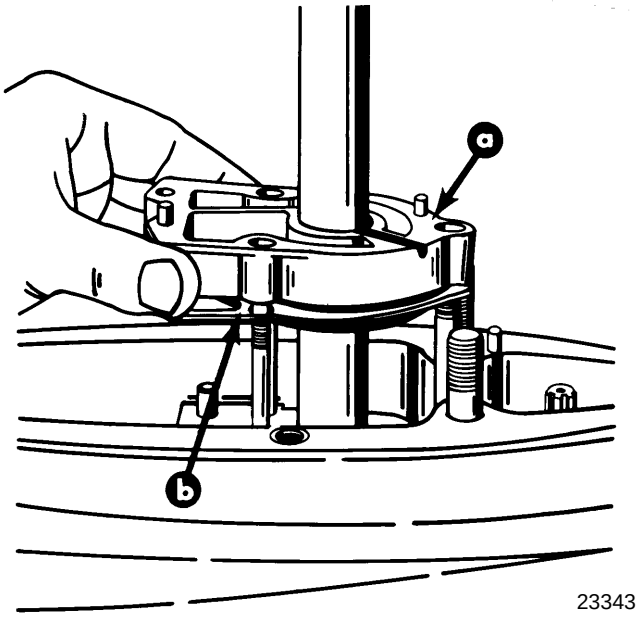
WATER PUMP INSTALLATION

1. If O-ring groove is present, cover drive shaft O-ring groove with a piece of tape.



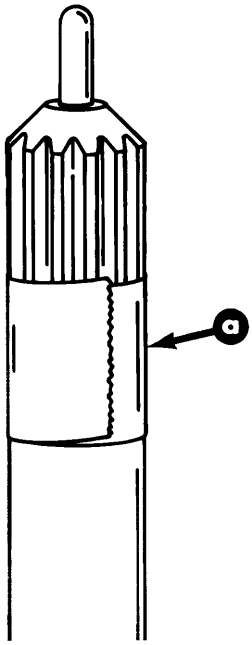
a - Tape On O-ring Groove (If O-ring Groove is Present)

2. Lubricate water pump base oil seal lips with 2-4-C Marine Lubricant and install water pump base with gasket over drive shaft.



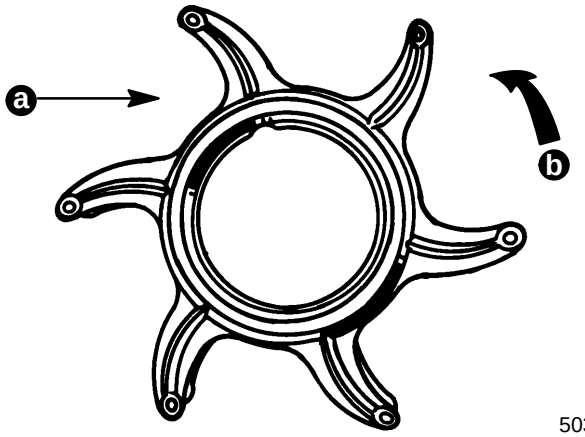
a - Water Pump Base
b - Gasket

3. Remove tape from drive shaft O-ring groove.



a - Tape On O-ring Groove (If O-ring Groove Is Present)

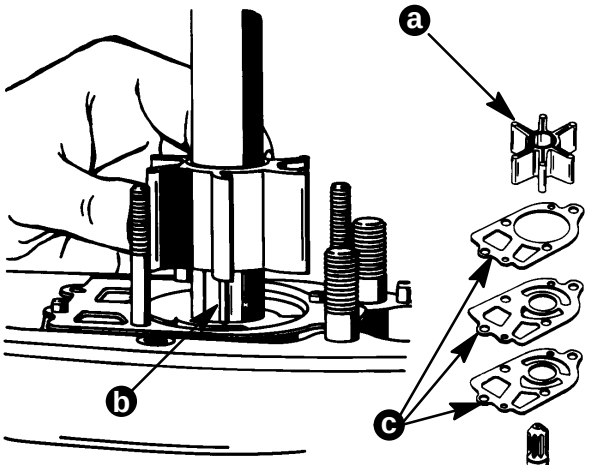
IMPORTANT: When completing repair which required removal of water pump impeller, it is recommended that the impeller be replaced. If it becomes necessary to reuse an impeller, DO NOT install reversed from original rotation, or premature impeller failure will occur. Face the curl of the blades in a counterclockwise direction.



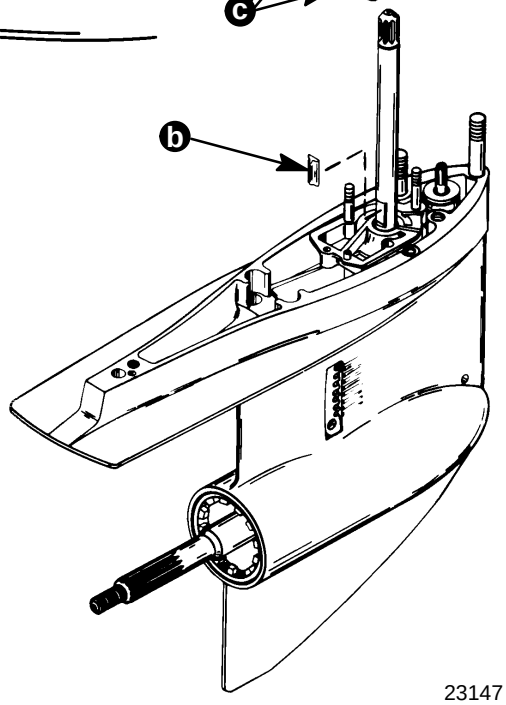
a - Impeller
b - Counterclockwise Direction

4. Install gaskets and face plate with one gasket on each side of face plate and lip on face plate facing toward water pump base.

5. Place a small dab of 2-4-C Marine Lubricant on drive key and place key on flat of drive shaft.
6. Slide water pump impeller over drive shaft (Impeller must slide on freely or shaft must be cleaned).
7. Align impeller key-way with key and set impeller on face plate.



23356

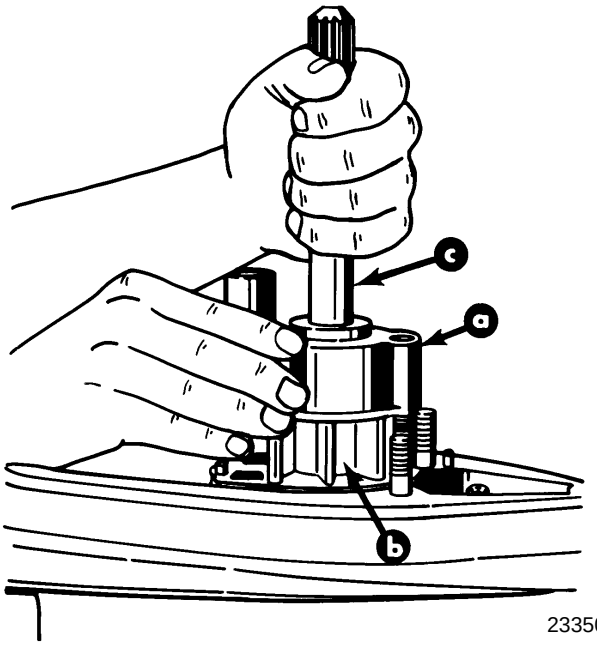


23147

a - Water Pump Impeller
b - Key
c - Water Pump Face Plate And Gaskets (One On Each Side)

8. Lightly lubricate water pump body insert with 2-4-C Marine Lubricant.

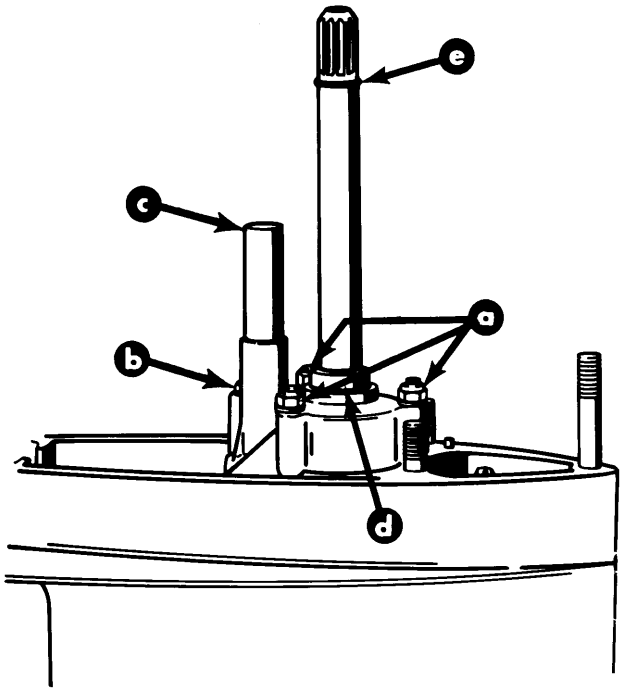
9. Position water pump body over drive shaft and water pump studs. Rotate drive shaft in a clockwise direction, while pushing down on water pump body to ease impeller entry into body.



23350

a - Water Pump Body
b - Water Pump Impeller
c - Drive Shaft

10. Install components as shown. Torque nuts to 60-80 lb. in. (6-9 N·m) and torque screw to 30-40 lb. in. (3-4 N·m).

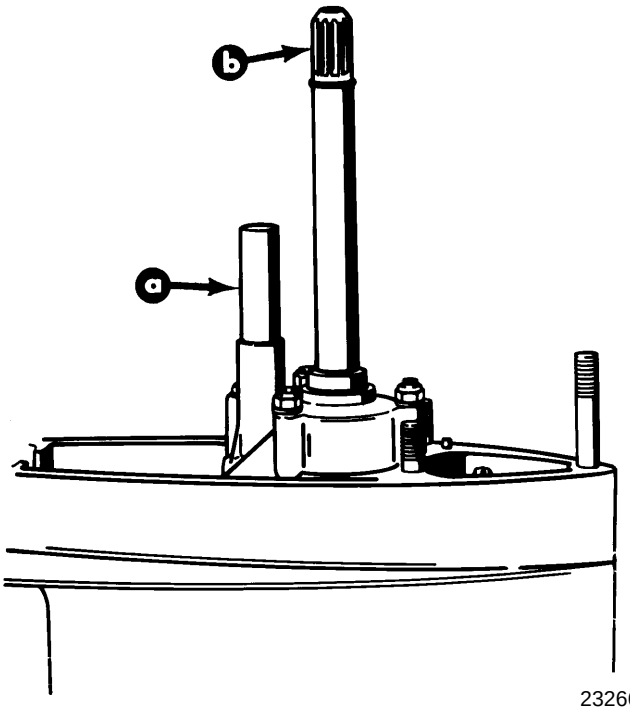


23266

a - Flat Washers and Nuts (3)
b - Screw
c - Water Tube (Plastic)
d - Centrifugal Slinger
e - O-ring (If O-ring Groove Is Present)

Gear Housing Installation

1. Lubricate end of water tube and drive shaft splines with 2-4-C Marine Lubricant. Do NOT lubricate top of drive shaft.

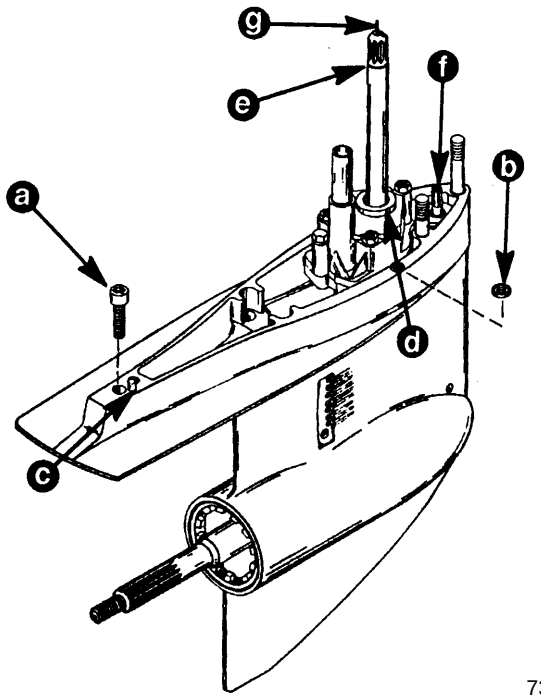


23266

a - Water Tube
b - Drive Shaft Splines

2. Install trim tab allen screw.
3. Install oil seal and apply Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal to oil seal.
4. Check that alignment pins, centrifugal slinger and drive shaft O-ring are in place on shaft with O-ring groove.
5. Move gear housing shift shaft clockwise to shift gear housing into forward gear.

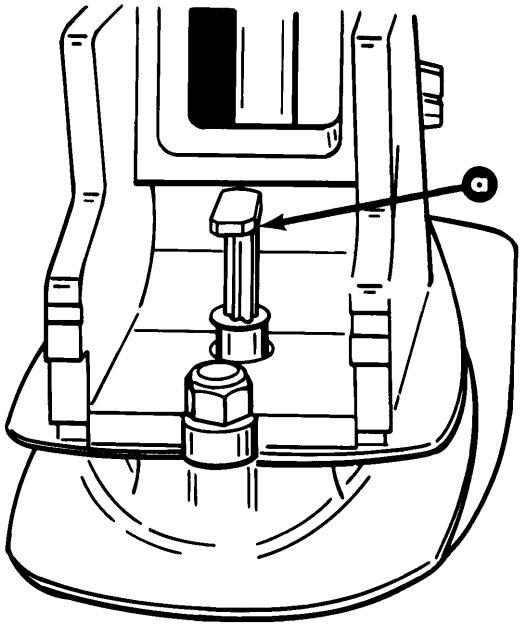
NOTE: *Gear housing may be held in forward gear by applying light pressure to propeller shaft in counter-clockwise direction.*



73989

a - Trim Tab Allen Screw
b - Oil Seal
c - Alignment Pin
d - Centrifugal Slinger
e - O-ring (If O-ring Groove Is Present)
f - Shift Shaft
g - Preload Pin

6. Place drive shaft housing shift shaft in the full forward position (straight ahead).



23265

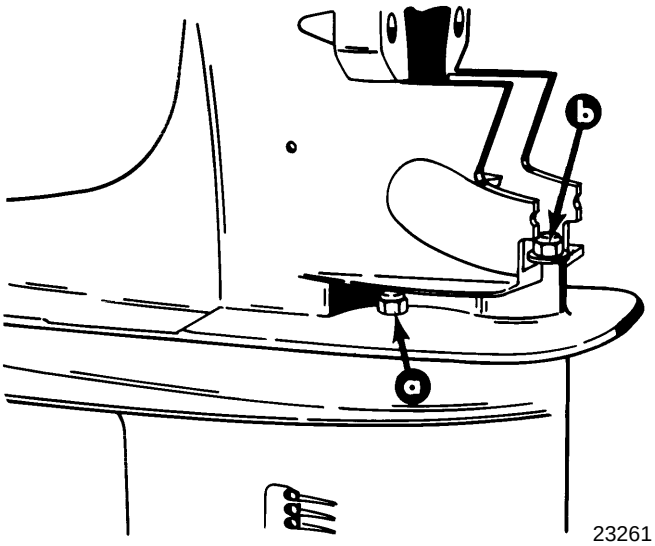
a - Upper Shift Shaft (In Drive Shaft Housing)

NOTE: *If propeller shaft is rotated in a clockwise direction before shift shafts are coupled, gear housing must be shifted back into forward gear and held in position.*

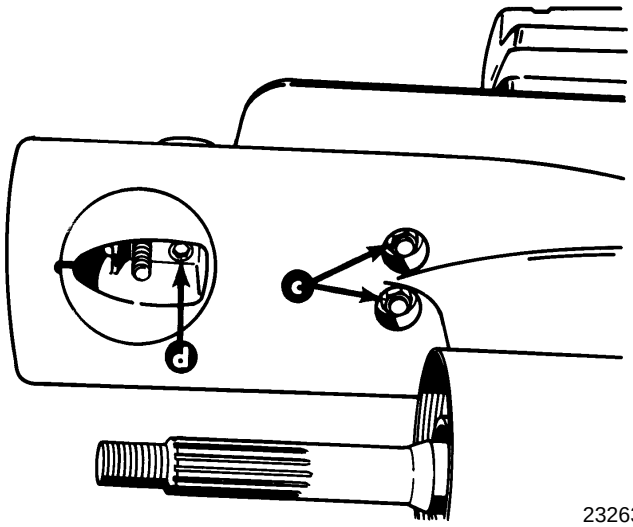
7. Align water tube with tube guide and drive shaft and shift shaft splines with upper drive shaft and shift shaft splines and install gear housing.

NOTE: *Rotate propeller shaft counterclockwise only after shift shaft splines have engaged. This will help engage drive shaft splines.*

8. Secure gear housing to drive shaft housing as shown. Torque locknuts to 35 lb. ft. (47 N·m). Torque allen screw to 28 lb. ft. (38 N·m).



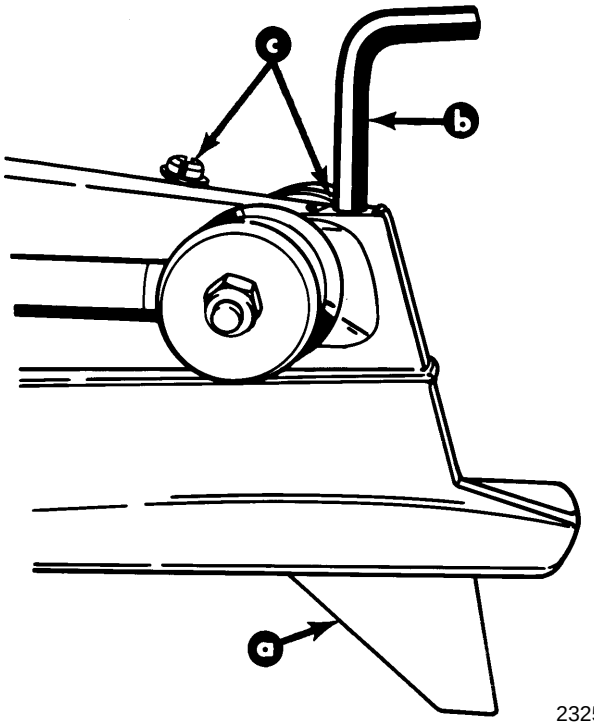
23261



23263

a - Locknuts (One Each Side)
b - Locknut
c - Locknuts
d - Allen Screw

9. Install trim tab and position according to marks made before disassembly. Torque to 30 lb. ft. (40 N·m). Reinstall plastic plug.



23253

a - Trim Tab
b - Allen Wrench
c - Plastic Plug

10. Refill drive unit with gear lubricant (Refer to Section 1-B).

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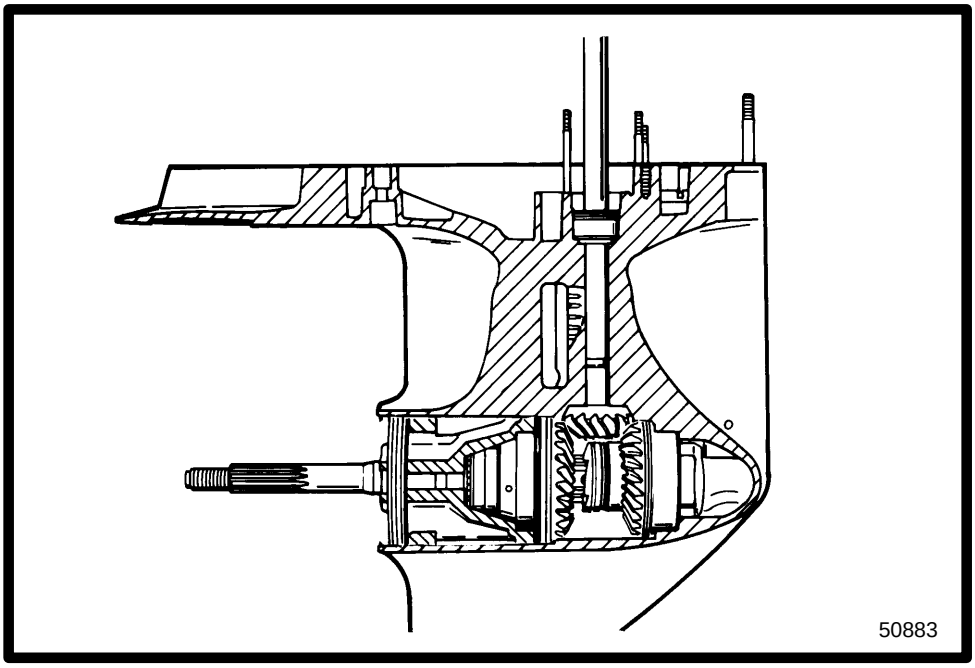
STERNDRIVE UNIT

3

D



ALPHA ONE COUNTER ROTATION GEAR HOUSING

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Identification

The Alpha One counter rotating gear housing can be identified by the letter “L” stamped at the end of the propeller shaft.

Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Nuts-Water Pump Body	90		10
Screw-Water Pump Body	20-30		2-3
Nut-Pinion Gear		60-80	81-108
Screw-Gear Housing To Drive Shaft Housing		28	38
Nuts-Gear Housing To Drive Shaft Housing		35	47
Screw-Trim Tab		23	31
Bushing-Shift Shaft		50	68
Retainer-Bearing Carrier		210	285
Driveshaft-Bearing Retainer		100	130

Shimming Specifications

Location	Specification
Forward Gear Backlash	.017-.028 in. (0.43-0.71 mm)
Reverse Gear Backlash	.020-.030 in. (0.50-0.76 mm)
Pinion Gear Height	.025 in. (0.64 mm)

Lubricants/Sealers/ Adhesives

Description	Part No.
Quicksilver 2-4-C Marine Lubricant	92-825407A2
3M Brand Adhesive	92-86166-1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
RTV Sealer / Loctite 587	92-809825
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver High Performance Gear Lube	92-816026A2
Loctite 27131	92-809820

Special Tools

Description	Part No.
Backlash Indicator Rod	91-53459
Bearing Carrier Retainer Wrench	91-61069
Bearing Preload Tool	91-14311A2
Dial Indicator	91-58222A1
Dial Indicator Holding Tool	91-89897
Drive Shaft Nut Wrench	91-56775
Drive Shaft Bearing Retainer Tool	91-43506
Oil Seal Driver	91-31108
Oil Seal Driver	91-44110
Pinion Gear Shimming Tool	91-56048
Pinion Nut Adaptor	91-61067A3
Puller Bolt	91-85716
Puller Jaws	91-46086A1
Shift Shaft Bushing Tool	91-31107
Slide Hammer Puller	91-34569A1
Torque Wrench-Lb. In.	91-66274
Universal Bearing Removal and Installation Tool (Components following)	91-312295A5
Bearing Adaptor	91-15755
Bearing Driver	91-52393
Bearing Driver	91-32336
Bearing Driver Rod	91-37323
Bearing Installation Tool	91-38628
Collar	91-30366-1
Driver Head	91-36569
Driver Head	91-37311
Driver Head	91-37312
Nut	11-24156
Pilot Washer	91-36571
Pilot Washer	91-37324
Pilot Washer	91-37350
Plate	91-29310
Puller Head	91-36379
Puller Rod	91-31229
Puller Rod Head	91-32325
Roller Bearing Removal and Installation Tool	91-37292
Washer	12-34961
Puller Rod	91-52394

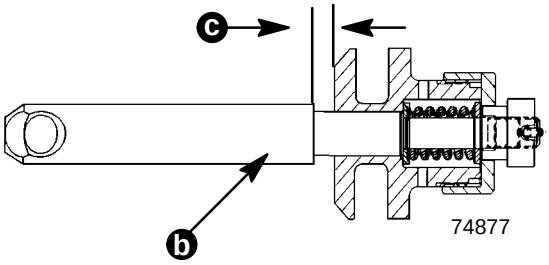
Special Information

⚠CAUTION

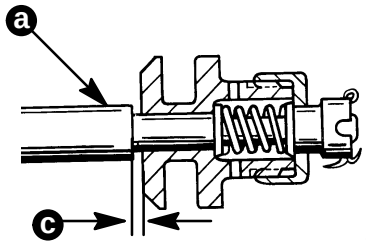
Avoid damage to sterndrive unit. Drive unit damage will occur if Later Style parts are intermixed with Earlier Style parts.

Shift Spool Assembly

The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool is sold as a whole assembly and can be used when replacing the earlier style. The end play for the spool will remain the same as the earlier models [.002-.010 in. (0.05-0.25 mm)].



74877

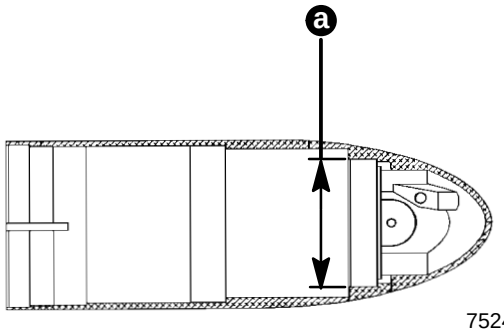


75219

a - Earlier Style Shift Spool Assembly (Prior to S/N 0K041000)
b - Later Style Shift Spool Assembly (S/N 0K041000 And Above)
c - Measure End Play Here at Gap

Forward Gear Bearing Bore

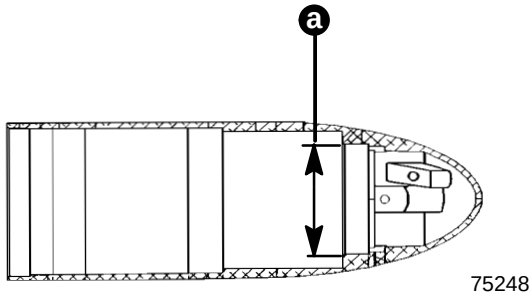
The later style forward gear bearing bore is smaller (3.2635 to 3.2650 in.) than the earlier style (3.4985 to 3.5000 in.). This slightly smaller bearing bore for the forward gear bearing adaptor is approximately 1/4 in. (6.3 mm) smaller.



75241

Earlier Style Forward Gear Bore

a - 3.4985-3.5000 in.



75248

Later Style Forward Gear Bore

a - 3.2635-3.2650 in.

The following is a supersession list to use when ordering the MCI or Alpha One lower gear housing as a **complete assembly** for replacement of the original lower unit.

Gear Housing Complete Supersession Listing				
Models	**Ratio**	**(Original) Gear Housing Assy Complete**	**Superseded by**	**Serial No. Range**
120	1.98:1	1623-5356A20	1623-8951A43	4893635 and up
140	1.98:1	1623-5356A20	1623-8951A43	4893635 and up
165	1.65:1	1623-5356A20	1623-8951A43	4890460 and up
470	1.84:1	1623-5356A20	1623-8951A43	4893835 and up
485	1.84:1	1623-5356A20	1623-8951A43	4893835 and up
225 - S	1.50:1	1623-5356A3	1623-8951A43	3856268 thru 4200499
228	1.50:1	1623-5356A3	1623-8951A43	4782330 and up
228	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
233	1.32:1	1623-8951A2	1623-8951A43	4200500 and up
250	1.32:1	1623-5356A3	1623-8951A43	4791300 and up
250	1.32:1	1623-8951A2	1623-8951A43	4791300 and up
260	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
888	1.50:1	1623-4110A6	1623-8951A43	3784374 and below
888	1.50:1	1623-4110A13	1623-8951A43	3784375 thru 3909577
888	1.50:1	1623-5356A3	1623-8951A43	3909578 and up
898	1.50:1	1623-8951A2	1623-8951A43	4782330 and up
898	1.50:1	1623-5356A20	1623-8951A43	4898730 and up
470	1.84:1	1623-5356A3	1623-8951A43	4208730 and up
470	1.84:1	1623-8951A2	1623-8951A43	4208730 and up
R	ALL	1623-5356A20	1623-8951A43	6225577 and up
MR	ALL	1623-5356A20	1623-8951A43	6225577 and up
Alpha One	ALL	1623-8951A23	1623-8951A43	6225577 and up
Alpha One	ALL	1623-8951A14	1623-8951A43	6225577 and up

The following is a supersession list to use when ordering the **Gear Housing Only** for replacement of the original lower unit.

Gear Housing Only Supersession List				
Models	**Ratio**	**(Original) Gear Housing Only**	**Superseded by**	**Serial No. Range**
120	1.98:1	1623-5356A4	None Required	4893635 and up
140	1.98:1	1623-5356A4	None Required	4893635 and up
165	1.65:1	1623-5356A4	None Required	4890460 and up
470	1.84:1	1623-5356A4	None Required	4893835 and up
470	1.84:1	1623-5356A4	None Required	4208730 and up
470	1.84:1	1623-5356A4	None Required	4208730 and up
485	1.84:1	1623-5356A4	None Required	4893835 and up
225 - S	1.50:1	1623-5356A4	None Required	3856268 thru 4200499
228	1.50:1	1623-5356A4	None Required	4782330 and up
228	1.50:1	1623-5356A4	None Required	4898730 and up
233	1.32:1	1623-5356A4	None Required	4200500 and up
250	1.32:1	1623-5356A4	None Required	4791300 and up
250	1.32:1	1623-5356A4	None Required	4791300 and up
260	1.50:1	1623-5356A4	None Required	4898730 and up
888	1.50:1	1623-4110A3	1623-5356A4	3784374 and below
888	1.50:1	1623-4110A3	1623-5356A4	3784375 thru 3909577
888	1.50:1	1623-5356A4	None Required	3909578 and up
898	1.50:1	1623-5356A4	None Required	4782330 and up
898	1.50:1	1623-5356A4	None Required	4898730 and up
R	ALL	1623-5356A4	None Required	6225577 and up
MR	ALL	1623-8951A15	1623-8951A37	6225577 and up
Alpha One	ALL	1623-8951A27 (Black)	1623-8951A37	6225577 and up
Alpha One	ALL	1623-8951A14 (Oyster)	1623-8951A37	6225577 and up

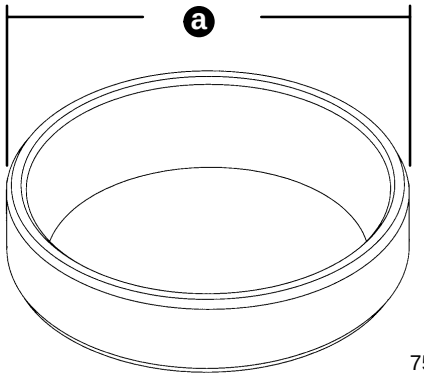
Before ordering a replacement **Gear Housing Only** for any of the previously listed units, you will need to look in the housing, at the cavity in front of the trim tab screw hole, for the casting number.

Order the appropriate housing number after determining the casting number.

GEAR HOUSING ONLY	
If Casting Number:	**Order Housing Number:**
1623-8950C 2	1623-8951A37
1623-8266C	1623-5356A4
1623-815822C 3	1623-815822A30

NOTE: *All of the numbers listed above are on the parts Micro-Fiche card.*

The 1623-815822A6 Gear Housing Only supersedes to 1623-815822A30. The A30 housing includes one 31-828439A2 forward gear bearing that allows you to install the 17/28 gears and the 14/28 gears into the new housing which has a 3.2635-3.2650 inch O.D. (82.89-82.93 mm) forward gear bearing bore.



75256B

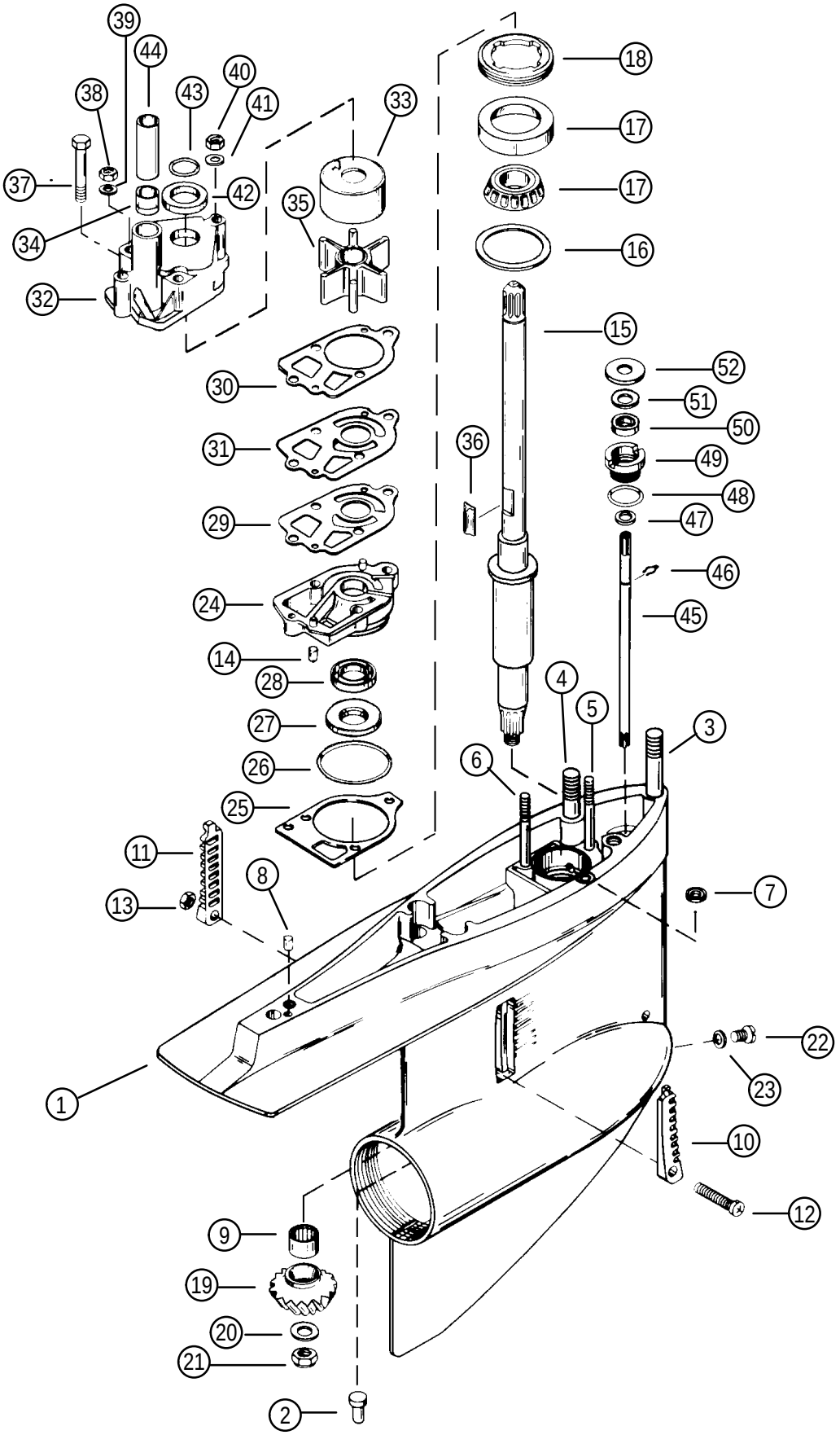
Bearing Cup 31-828439A2

a - 3.2635-3.2650 in (82.89-82.93 mm) O.D.

When Ordering Gear Housing:	FWD. Gear Bearing Supersedes To:	Current Part Number:
1623-8951A27 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	1623-8951A37 3.2635-3.2650 in. O.D. (82.89-82.93 mm) Fwd. Gr. Brg.
1623-815822A6 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	1623-815822A30 3.2635-3.2650 in. O.D. (82.89-82.93 mm) Fwd. Gr. Brg.

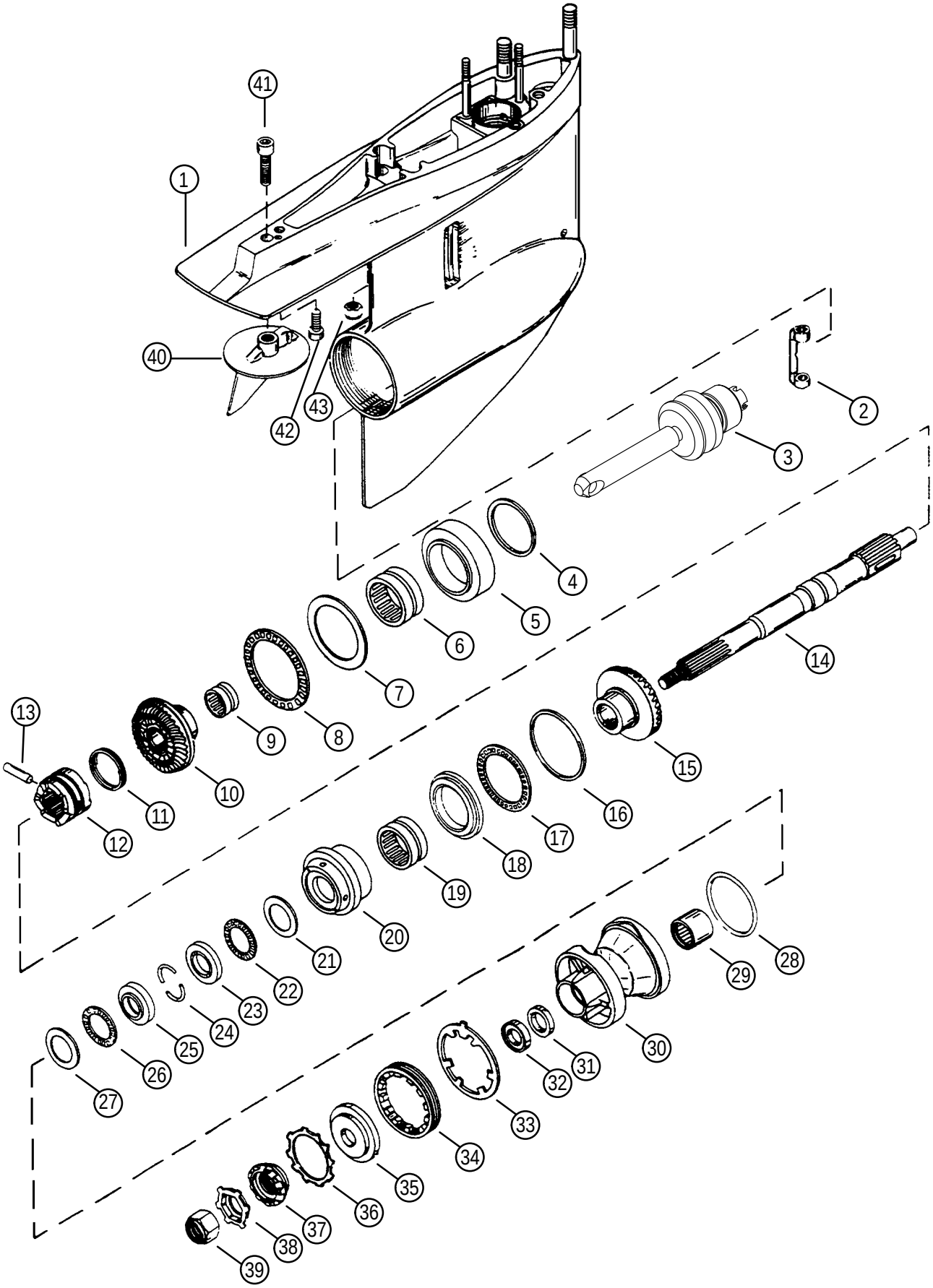
When Ordering Gear Housing:	Along With:	Gear Set	Also Requires:	Forward Gear Bearing
1623-8951A27 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	43-828072A2 or 43-828072A3 (13/21)	➔	31-30894A1 3.2635-3.2650 in. OD. (82.89-82.93 mm) Fwd. Gr. Brg.
1623-815822A6 3.4895-3.5000 in. O.D. (88.86-88.90 mm) Fwd. Gr. Brg.	➔	43-828072A2 or 43-828072A3 (13/21)	➔	31-30894A1 3.2635-3.2650 in. OD. (82.89-82.93 mm) Fwd. Gr. Brg.

Exploded View - Alpha One Counter Rotating Gear Case



23135

1 - Gear Housing Assembly
2 - Pin
3 - Stud
4 - Stud
5 - Stud
6 - Stud
7 - Seal
8 - Dowel Pin
9 - Roller Bearing
10- Insert
11- Insert
12- Screw
13- Nut
14- Groove Pin
15- Drive Shaft Assembly
16- Shim
17- Tapered Roller Bearing
18- Nut
19- Gear Set (Pinion and Forward Gears)
20- Washer
21- Nut
22- Screw
23- Washer
24- Water Pump Base Assembly
25- Gasket
26- O-ring
27- Oil Seal
28- Oil Seal
29- Lower Gasket
30- Upper Gasket
31- Face Plate
32- Water Pump Body Assembly
33- Water Pump Insert
34- Seal
35- Impeller
36- Key
37- Screw
38- Nut
39- Washer
40- Nut
41- Washer
42- Ring
43- O-ring
44- Sleeve
45- Lower Shift Shaft
46- Retaining Clip
47- Washer
48- O-ring
49- Bushing Assembly
50- Oil Seal
51- Washer
52- Washer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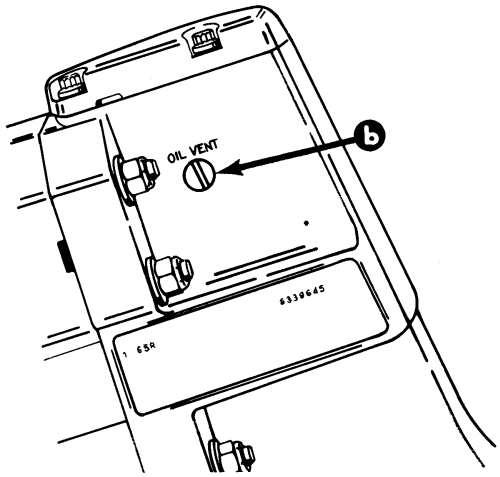
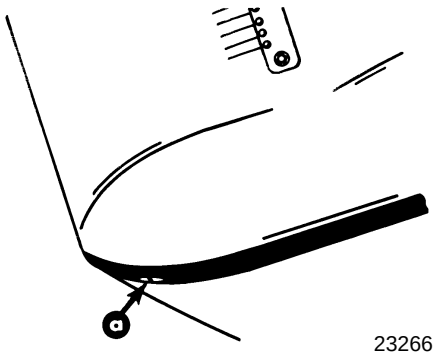
1- Gear Housing
2- Shift Crank
3- Shift Spool Assembly
4- Shims
5- Reverse Gear Bearing Adaptor
6- Roller Bearing
7- Thrust Washer
8- Thrust Bearing
9- Roller Bearing
10 - Reverse Gear
11 - Pin Retainer Spring
12 - Sliding Clutch
13 - Cross Pin
14 - Propeller Shaft
15 - Forward Gear
16 - Shim
17 - Roller Bearing
18 - Thrust Race
19 - Roller Bearing
20 - Forward Gear Bearing Adaptor
21 - Thrust Washer
22 - Thrust Bearing
23 - Thrust Collar
24 - Keepers
25 - Thrust Collar
26 - Thrust Bearing
27 - Thrust Washer
28 - O-ring
29 - Needle Bearing
30 - Bearing Carrier
31 - Oil Seal
32 - Oil Seal
33 - Tab Washer
34 - Bearing Carrier Retainer
35 - Thrust Hub
36 - Continuity Washer
37 - Splined Washer
38 - Tab Washer
39 - Propeller Nut

Separate Drive Shaft Housing From Gear Housing

1. Tilt drive unit at a 45 degree angle, remove fill/drain screw; then remove oil vent screw. Allow drive unit to drain completely.



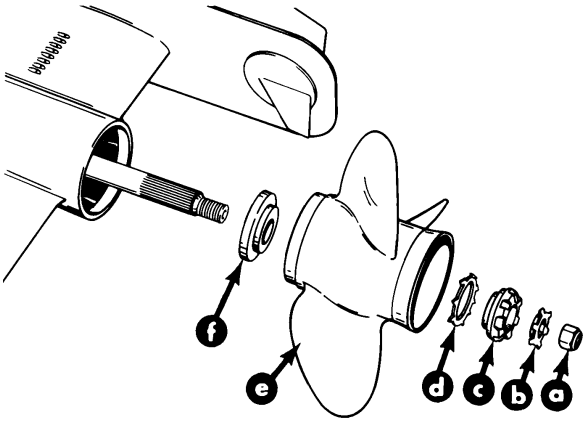
23263



23266

a - Fill/Drive Screw
b - Vent Screw

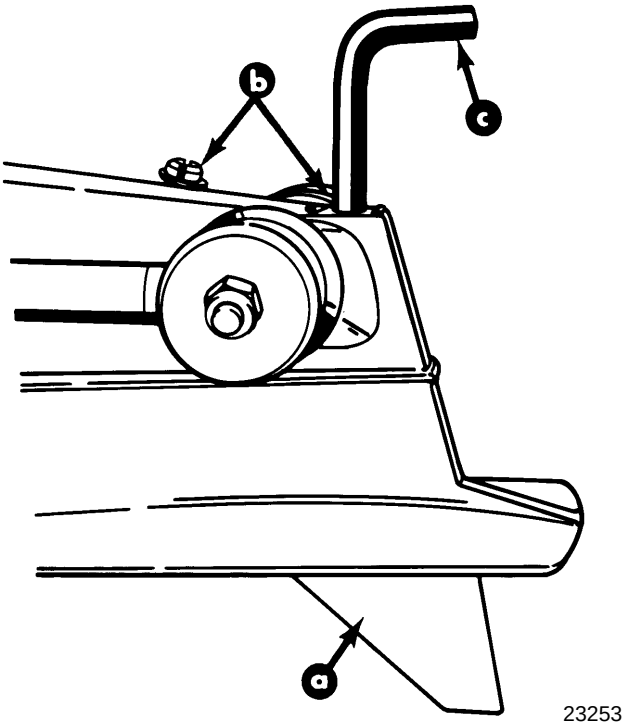
2. Remove propeller.



22074

a - Propeller Nut
b - Tab Washer
c - Spline Washer
d - Continuity Washer
e - Propeller
f - Thrust Hub

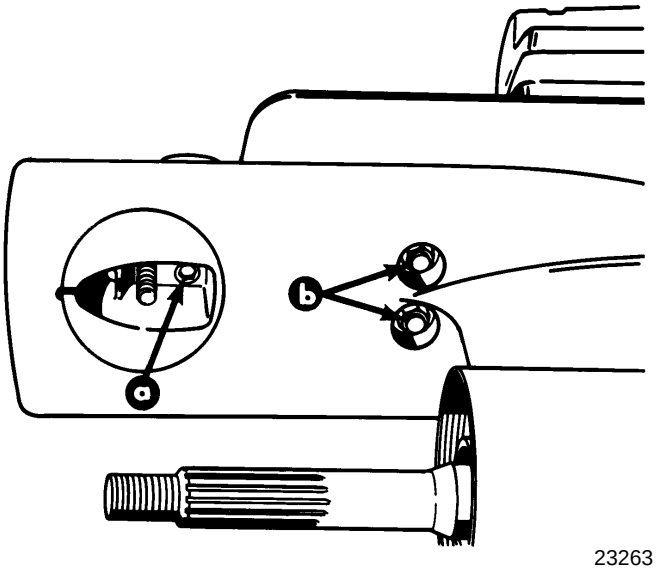
3. Mark trim tab position with a piece of tape; then remove trim tab.



23253

a - Trim Tab
b - Plastic Plug (From Access Hole)
c - 3/8 in. Allen Wrench

4. Remove gear housing as follows:
   a. Remove allen screw and locknuts from bottom side of gear housing.



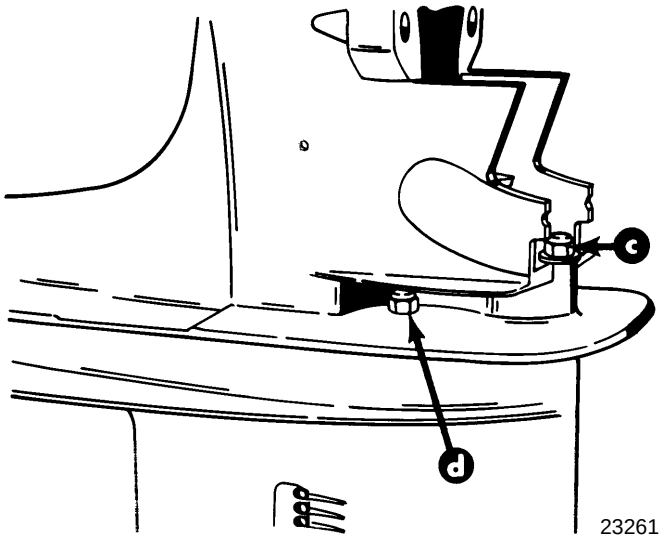
23263

a - Allen Screw (In Trim Tab Cavity)
b - Locknuts

b. Remove locknut from front side of drive shaft housing.

c. Loosen locknuts (one on each side of gear housing). DO NOT attempt to remove one nut before opposite side is loosened sufficiently or drive shaft housing could be damaged.

d. Pull gear housing away from drive shaft housing as far as nuts will allow. Remove loosened nuts.

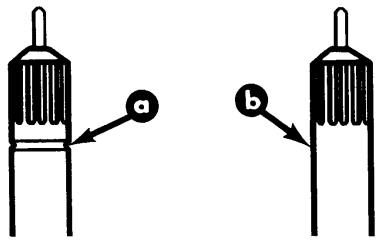


23261

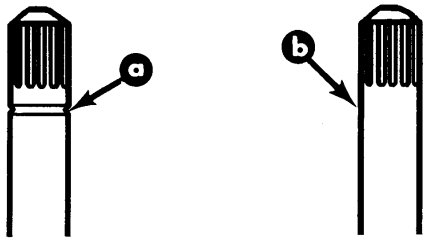
c - Locknut (Top Front)
d - Locknuts (One Each Side)

ALPHA I and MC I DRIVE SHAFT CHANGES

The service drive shaft for the lower unit will no longer have an O-ring groove at the top of the shaft under the splines on all Alpha One 1990 and prior and also MC I through 1976. All present production units contain the New Style shaft without an O-ring groove also.



a - MC I Old Style (With O-ring Groove)
b - Mc I999 New Style (Without O-ring Groove)



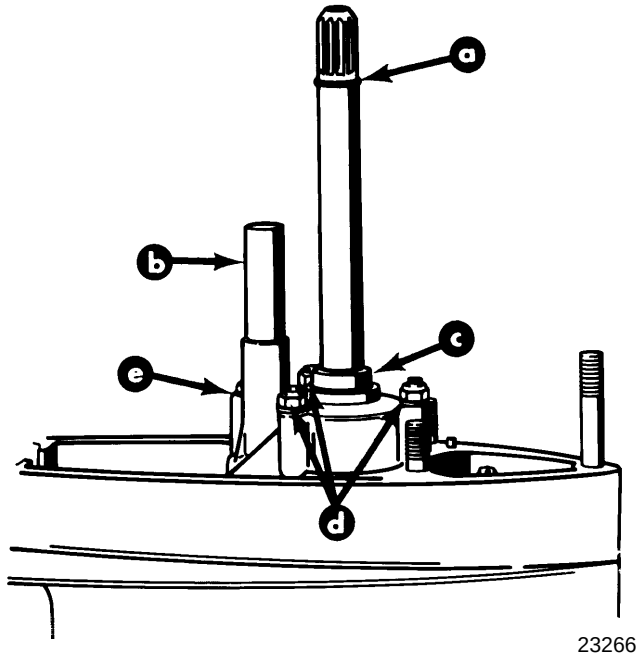
71185

a - Alpha One Old Style (With O-ring Groove)
b - MC I New Style (Without O-ring Groove)

Gear Housing Disassembly

NOTE: *If O-ring remains lodged between upper drive shaft seals (in drive shaft housing), be sure to remove O-ring or reassembly will be impaired.*

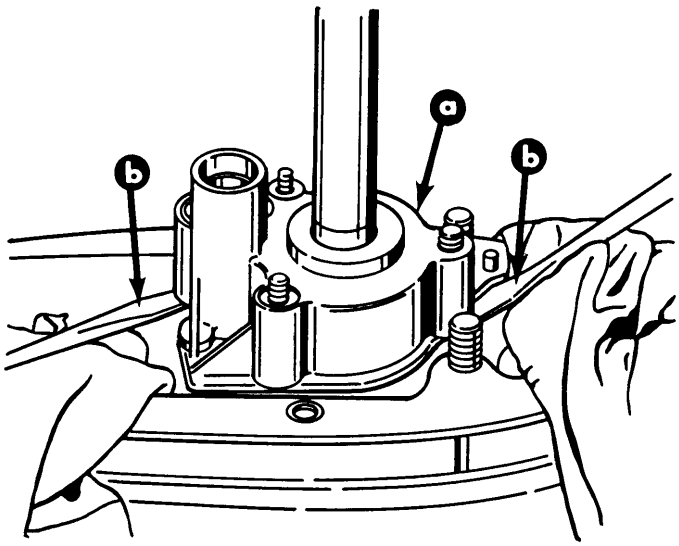
1. Remove components shown.



23266

a - O-ring (If O-ring Groove Is Present)
b - Water Tube
c - Rubber Centrifugal Slinger
d - Locknuts
e - Self-Tapping Screw

2. Carefully lift water pump body from gear housing.

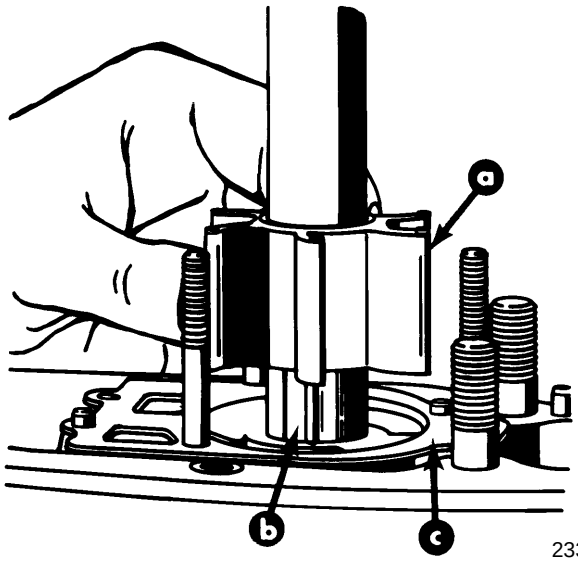


23349

a - Water Pump Body
b - Pry Bars

3. Remove water pump impeller.

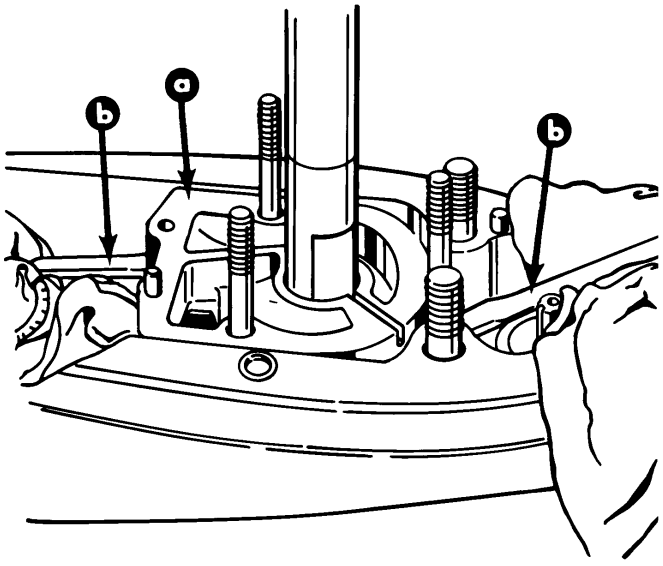
NOTE: *It may be necessary to use a punch and hammer to drive impeller upward on drive shaft. In extreme cases, it may be necessary to split hub of impeller with hammer and chisel.*



23356

a - Water Pump Impeller
b - Drive Key
c - Water Pump Face Plate And Gaskets (One On Each Side Of Face Plate)

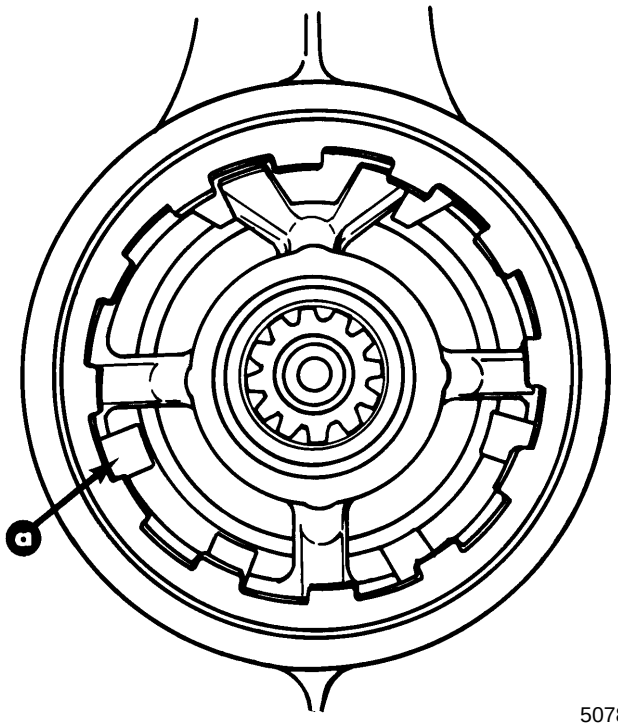
4. Remove water pump base from gear housing.



23356

a - Water Pump Base
b - Pry Bars

5. Straighten tabs on bearing carrier tab washer.

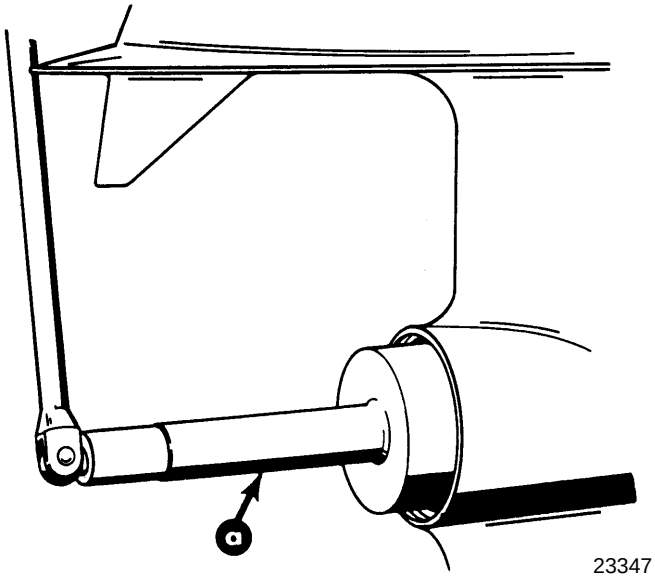


50784

a - Tab On Tab Washer

6. Remove bearing carrier retainer following Step a or b as follows:

   a. Remove bearing carrier retainer using bearing carrier retainer wrench (91-61069).



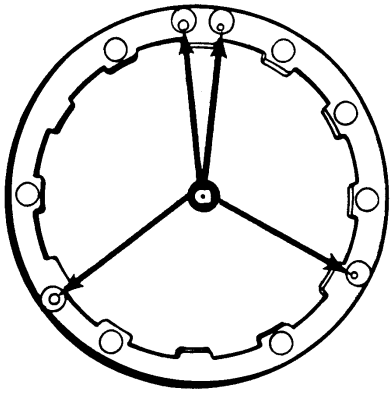
23347

a - Bearing Carrier Retainer Wrench

⚠ CAUTION

DO NOT drill into gear housing retainer threads if using following procedure for removing retainer.

b. If retainer is corroded in place, drill 4 holes in retainer and fracture retainer with a chisel. Pry out remaining segments.

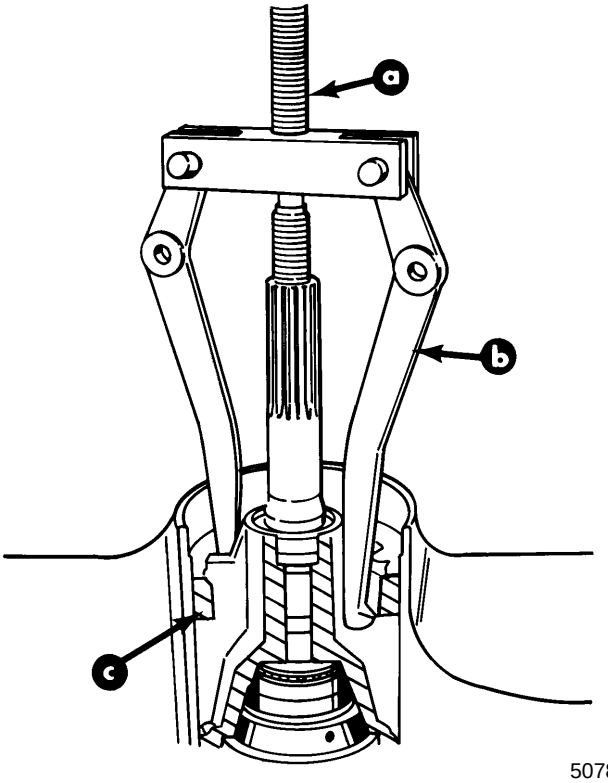


23356

a - Drilled Holes

NOTE: *If bearing carrier is seized in gear housing, it may be necessary to use heat to loosen carrier.*

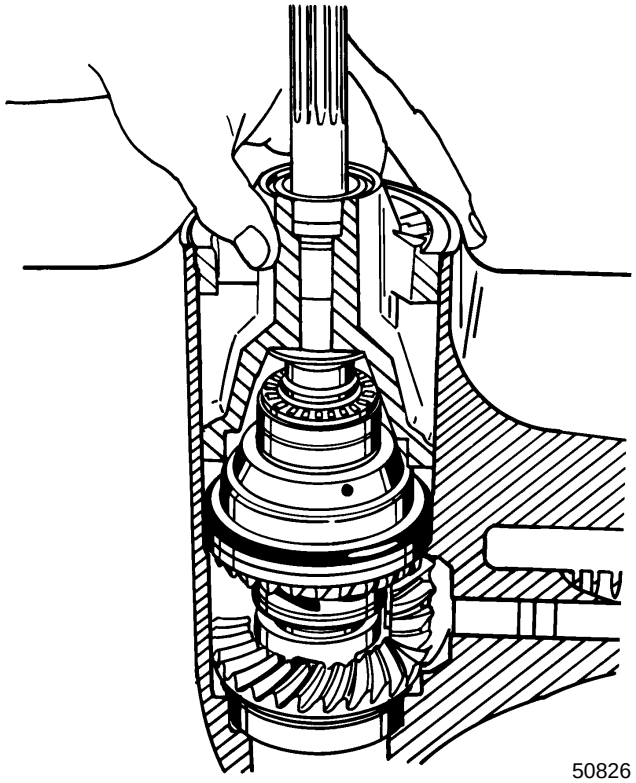
7. Pull bearing carrier from gear housing using a two jaw puller. Be sure that jaws are positioned on strengthened portion of bearing carrier outer ring (top and bottom).



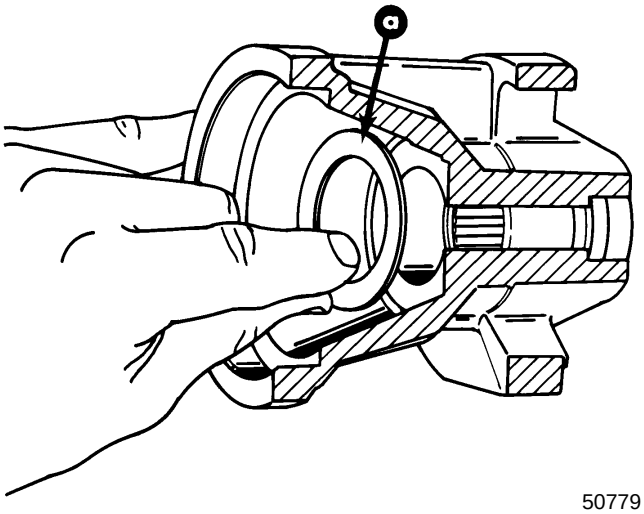
50786

a - Puller Bolt (91-85716)
b - Puller Jaws (91-46086A1)
c - Bearing Carrier Hub

8. Lift bearing carrier from gear housing. Locate and retain thrust washer that may be stuck to surface inside of bearing carrier.



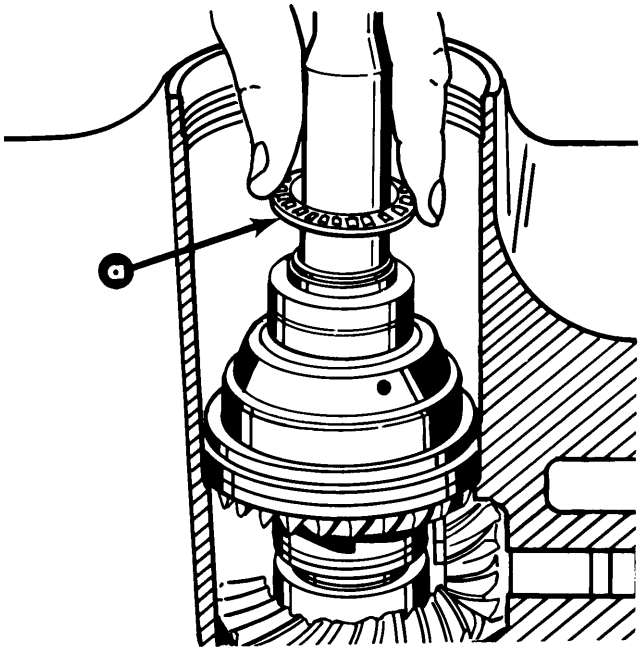
50826



50779

a - Thrust Washer

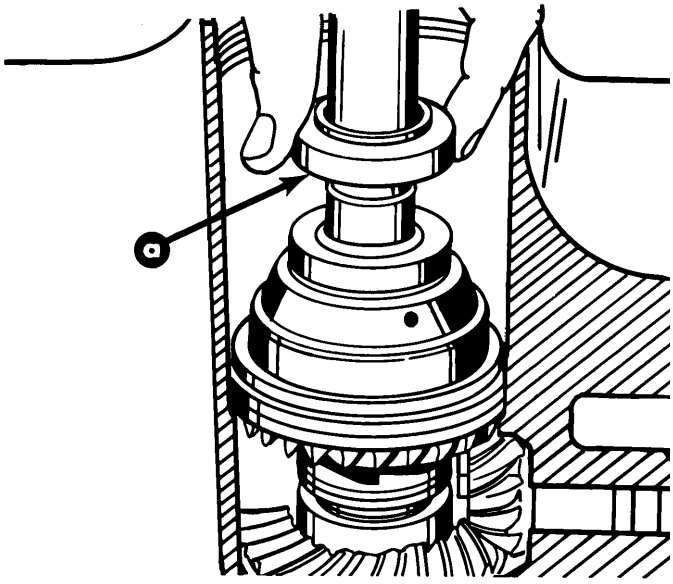
9. Remove rear thrust bearing.



50786

a - Thrust Bearing

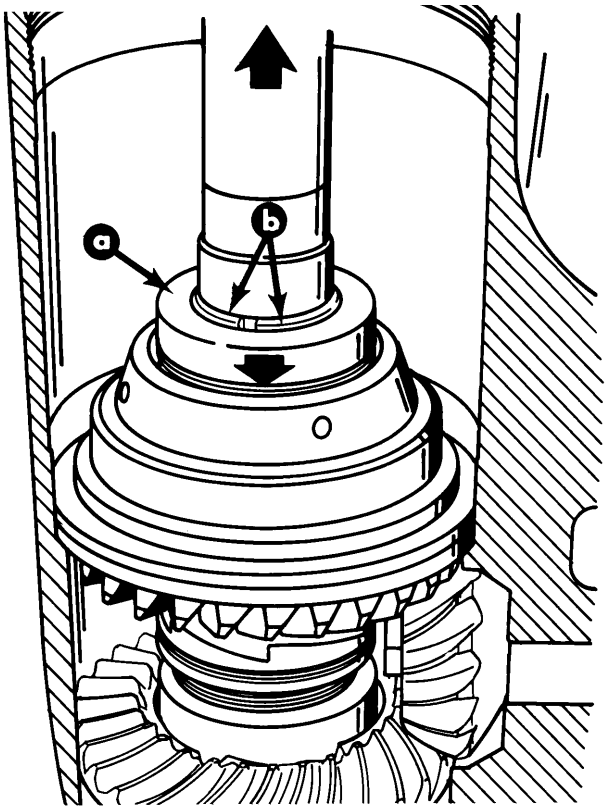
10. Remove rear thrust collar.



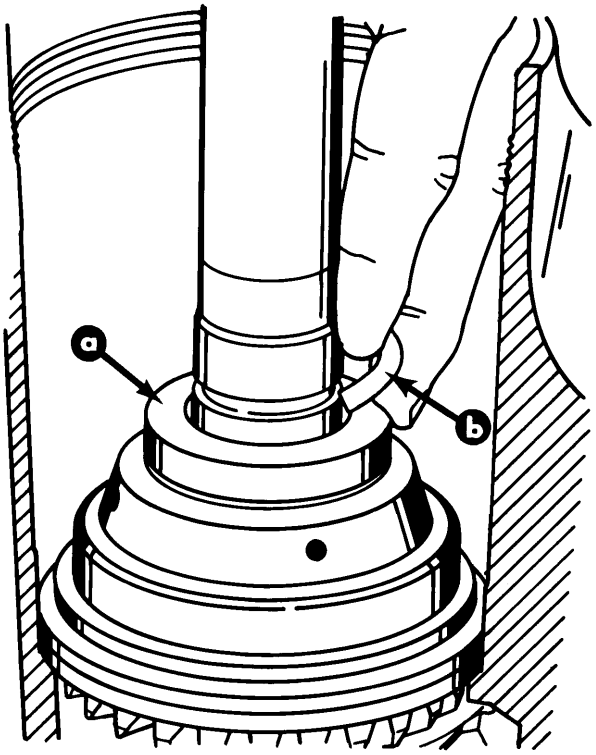
50787

a - Thrust Collar

11. Lift up on propeller shaft and push down on front thrust collar to remove two keepers.



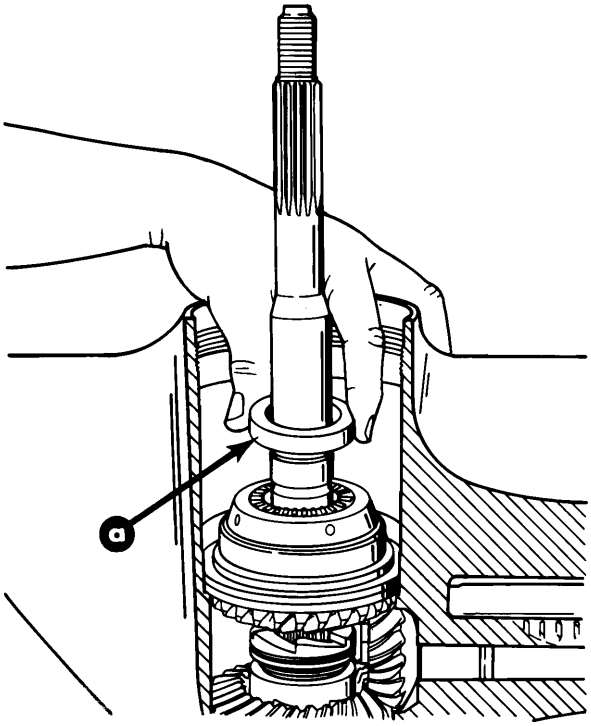
50778



50826

a - Thrust Collar
b - Keepers (2)

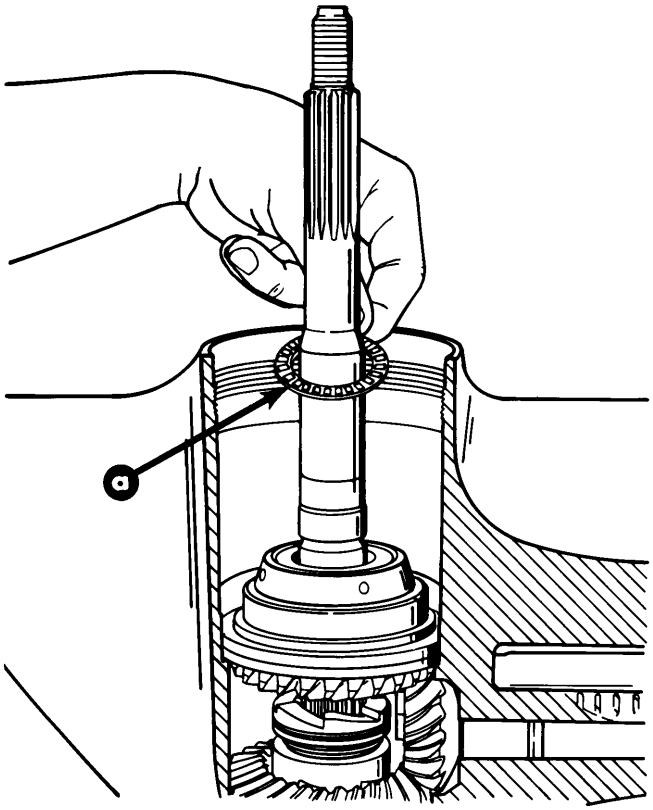
12. Remove front thrust collar.



50784

a - Thrust Collar

13. Remove front thrust bearing.

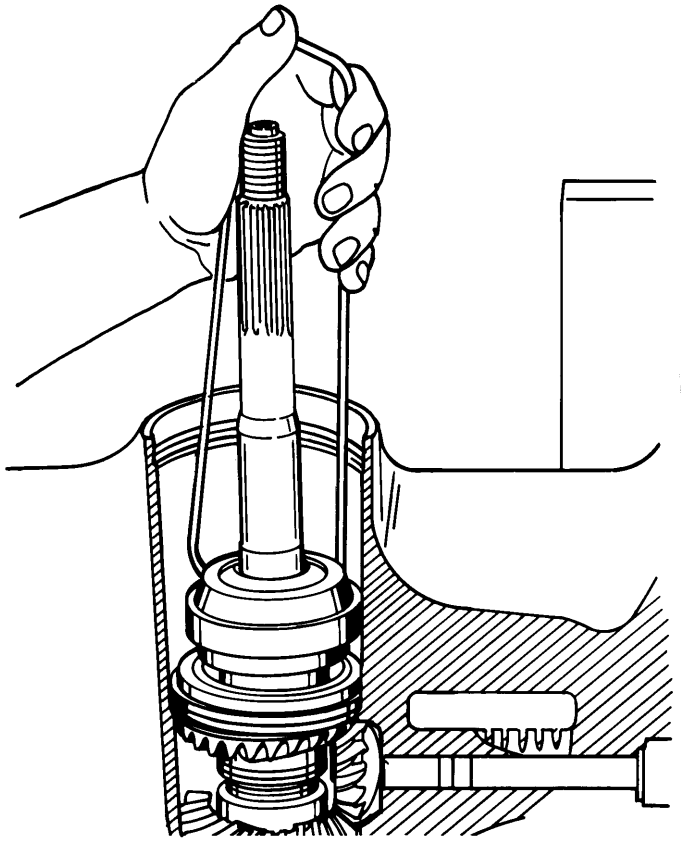


50783

a - Thrust Bearing

14. Remove forward gear bearing adaptor.

NOTE: *Form a tool using 1/8 in. (3 mm) wire.*

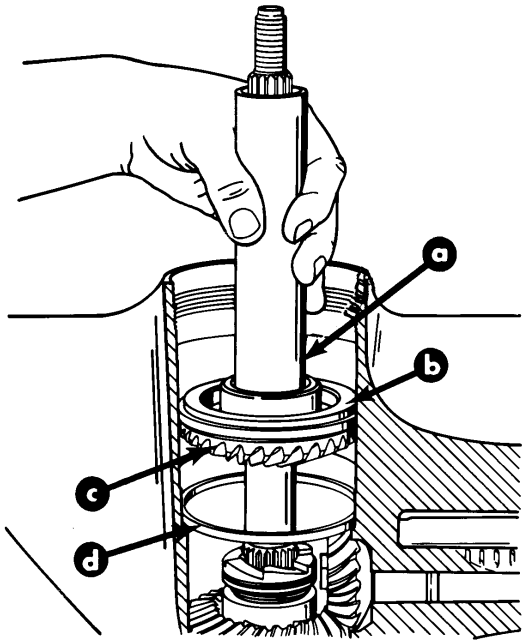


50786

NOTE: *The thrust race that must be removed in the following step has a tight fit in the gear housing bore. Use Special Tool (91-815850) to attempt to remove thrust race and forward gear together. If this attempt fails, form a small hook on the end of a stiff piece of wire and try to pull thrust race up by hooking onto inside edge and pulling.*

15. Remove forward gear, thrust race, O-ring and thrust bearing (between gear and race).

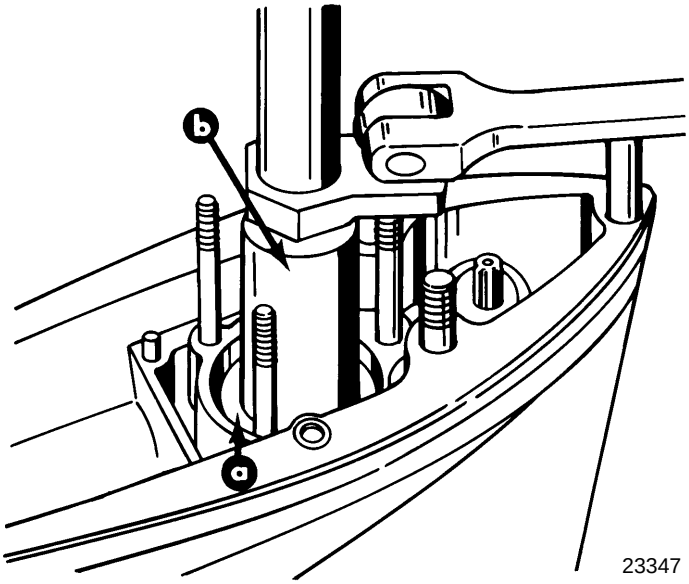
16. Remove forward gear shim.



50783

a - Special Tool
b - Thrust Race
c - Forward Gear
d - Shim

17. Loosen drive shaft bearing retainer 2 or 3 turns. DO NOT remove at this time.

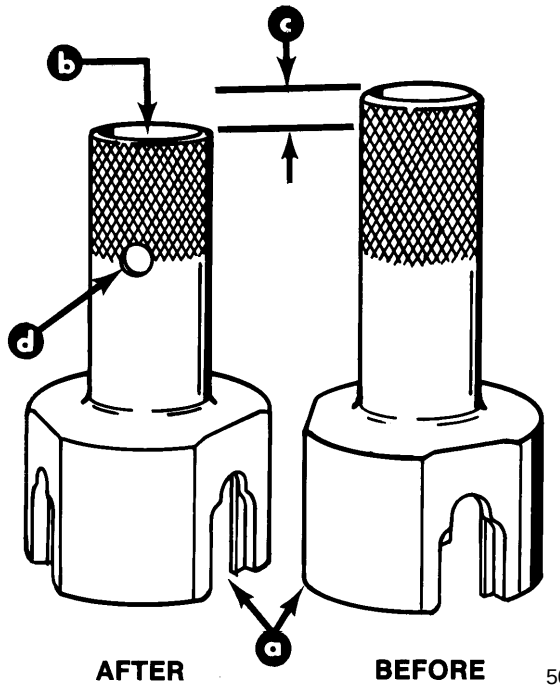


23347

a - Bearing Retainer
b - Bearing Retainer Wrench (91-43506)

IMPORTANT: Pinion Nut Adaptor in kit 91-61067A2 will have to be modified to be able to use it on this gear housing. The tube on this tool must be bored out approximately .030 in. (0.8 mm) to a finished I.D. of 1.27 in. (32.38 mm). This allows tool to fit over propeller shaft on the counter rotation gear housing. The tube also needs to be shortened by approximately 5/8 in. (16 mm) to be used later on in the reassembly of the gear housing.

Pinion Nut Adaptor in kit 91-61067A3 does not need to be modified.



50881

a - Pinion Nut Adaptor (91-61067A2)
b - Tube I.D. - 1.27 in. (32.38 mm)
c - Cut Off 5/8 in. (16 mm)
d - Drill Hole - 1/2 in. (14 mm)

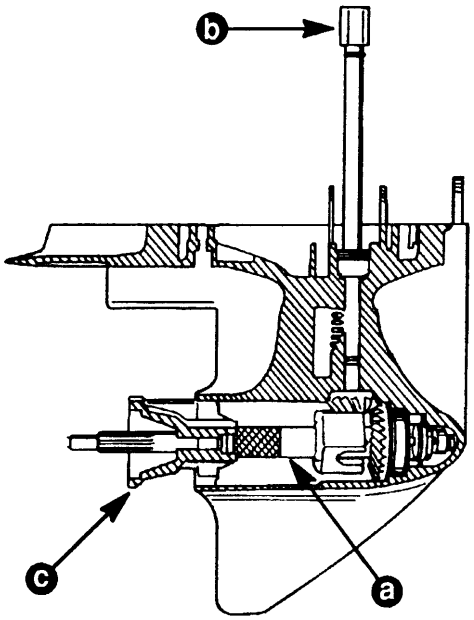
18. Remove drive shaft pinion nut as follows:

a. Place drive shaft adaptor over drive shaft splines.

b. Pull up on drive shaft and place pinion nut adaptor over propeller shaft and onto pinion gear nut.

c. Place bearing carrier into gear housing bore backwards to provide support to shaft and keep pinion nut adaptor on nut.

d. Turn drive shaft counterclockwise to loosen and remove pinion nut.



73873

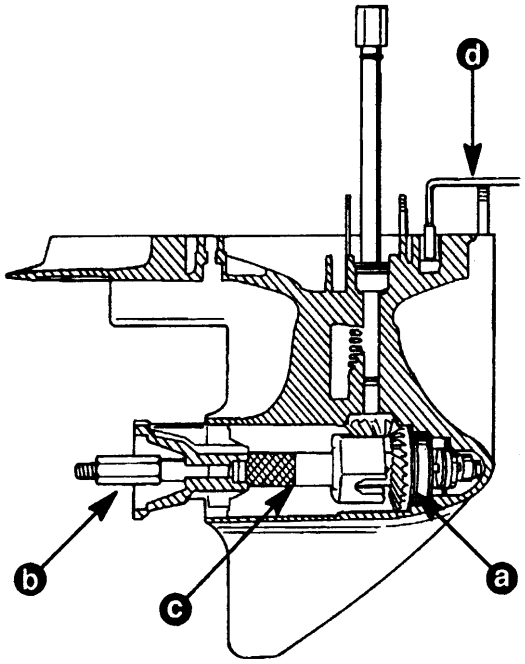
a - Pinion Nut Adaptor
b - Drive Shaft Adaptor
c - Bearing Carrier

e. If drive shaft is broken:

(1) Place propeller shaft tool onto propeller shaft.

(2) Shift gear housing into reverse gear position and maintain pressure on shift handle tool to keep clutch engaged with reverse gear.

(3) Turn propeller shaft counterclockwise to turn gear and loosen and remove pinion nut.



73874

a - Reverse Gear
b - Propeller Shaft Tool
c - Pinion Nut Adaptor
d - Shift Handle Tool

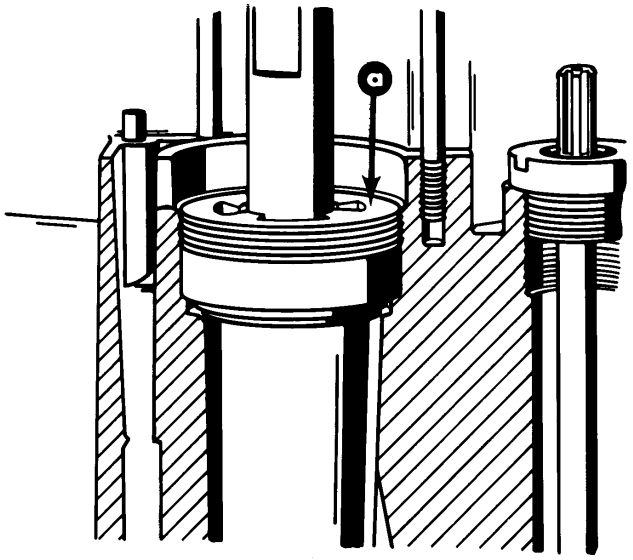
NOTE: *Propeller shaft tool 91-61077 is included with Pinion Nut Adaptor 91-61067A3.*

19. Remove the drive shaft bearing retainer.

20. Remove bearing carrier and special tools. Be sure to locate and retain pinion nut and washer.

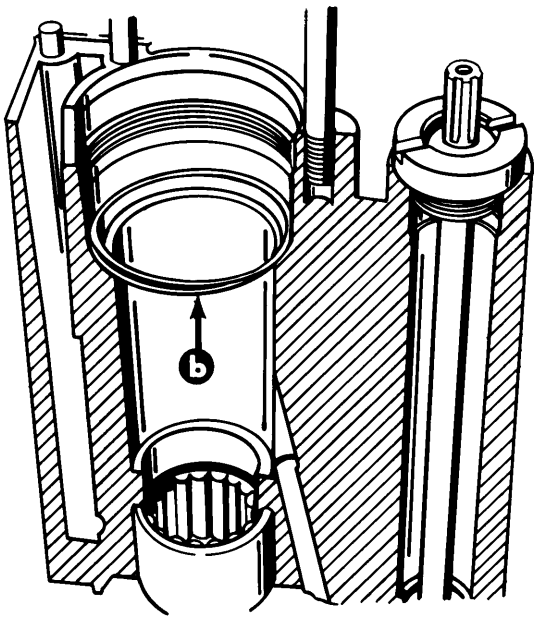
IMPORTANT: Pinion bearing rollers are free to fall out of outer bearing race once drive shaft is removed. Be careful not to loose any of the 18 rollers.

21. Remove drive shaft bearing retainer and lift drive shaft out of gear housing. Remove shims and measure thickness for future reference.



23352

a - Bearing Retainer



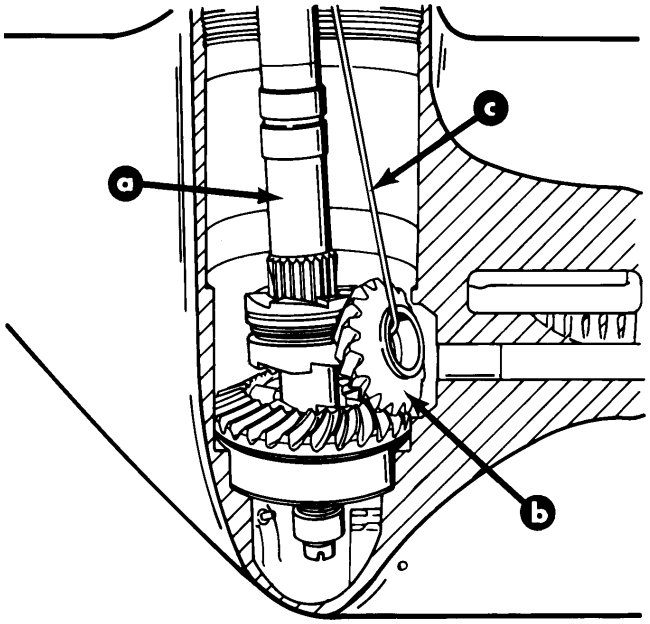
23351

b - Shims

22. Remove pinion gear as follows:

    a. Lift up on propeller shaft to partially disengage shaft from gear enough to tilt propeller shaft downward (away from pinion gear).

    b. Form a small hook on a stiff piece of wire and attempt to hook onto top side of gear and pull it out. It may be necessary to slightly move propeller shaft from side-to-side to dislodge pinion gear.



50884

a - Propeller Shaft
b - Pinion Gear
c - Wire

⚠CAUTION

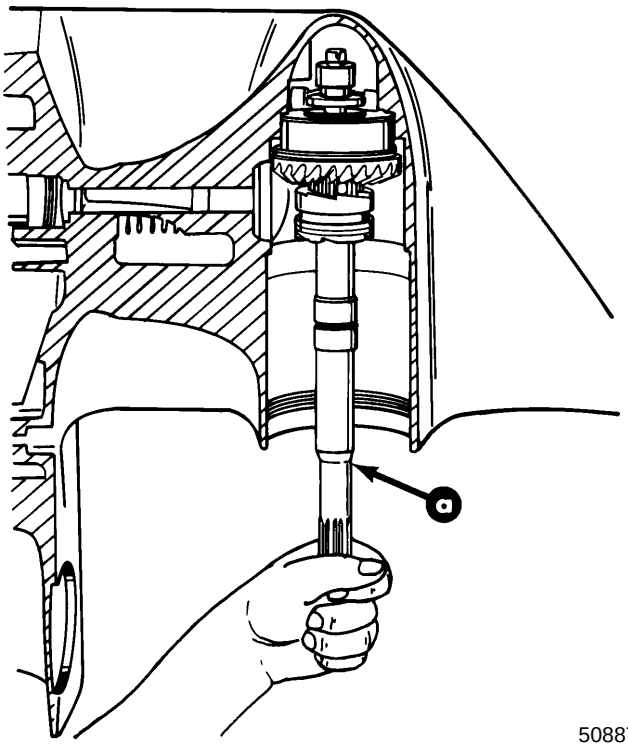
Hold onto propeller shaft assembly in the following step to avoid dropping components when turning gear housing over as components could be damaged.

23. Remove propeller shaft, reverse gear and shift spool assembly as follows:

    a. While holding onto propeller shaft, turn gear housing so that bore opening is facing down.

    b. Lower propeller shaft while simultaneously moving it to the left (port) side of gear housing to allow shift spool to disengage from shift crank. Remove propeller shaft assembly.

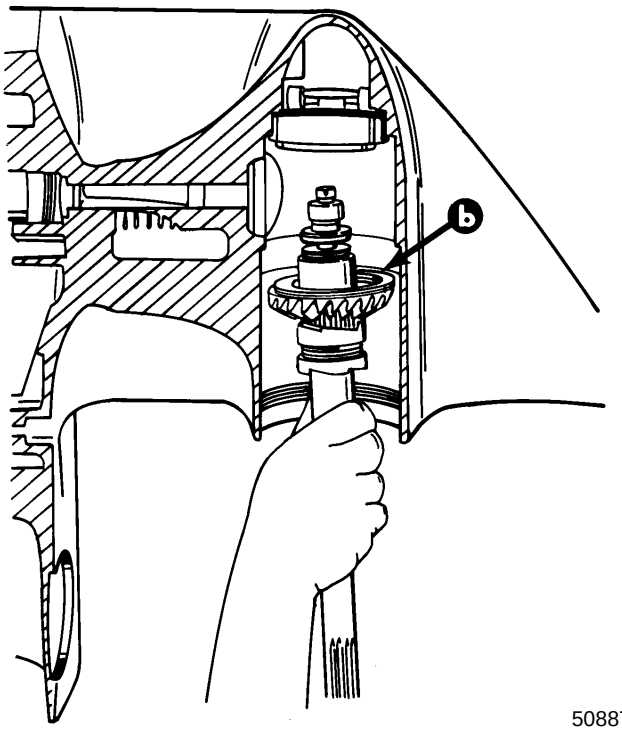
NOTE: *It is possible in the performance of the above procedure that a roller(s) can be dislodged from inside the reverse gear roller bearing. If this is encountered, simply snap the roller back into place (Provided the roller or bearing cage is not damaged).*



50887

a - Propeller Shaft Assembly

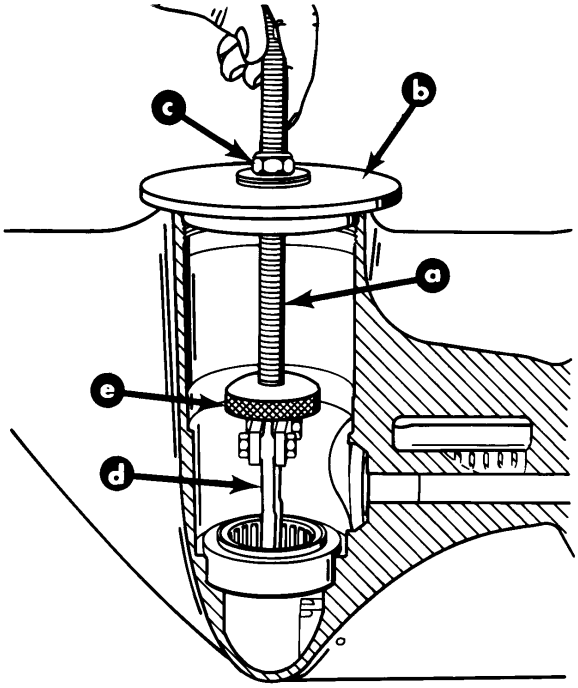
c. Locate and retain thrust race and thrust bearing which could be on top of reverse gear (If not, they may be stuck to reverse gear bearing adaptor).



50887

b - Thrust Bearing And Race

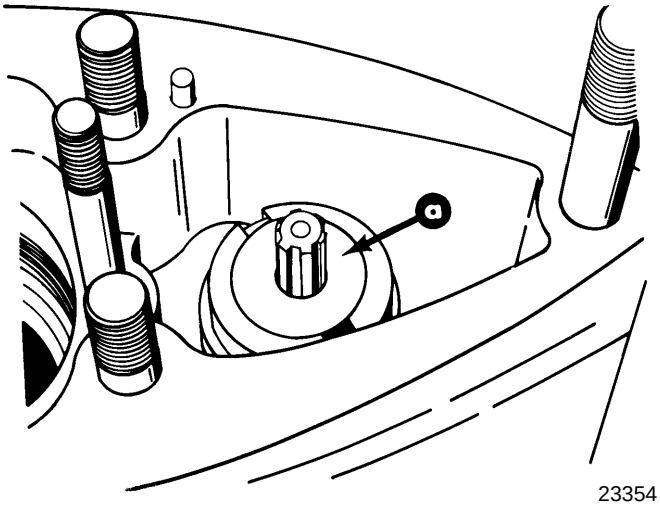
24. Remove reverse gear bearing adaptor and shims using tools as shown. Measure shim thickness for future reference.



50780

a - Puller Shaft (91-31229)
b - Guide Plate (91-816243)
c - Nut (11-24156)
d - Jaws (91-816242)
e - Puller Head (From Slide Hammer Puller Kit 90-34569A1)

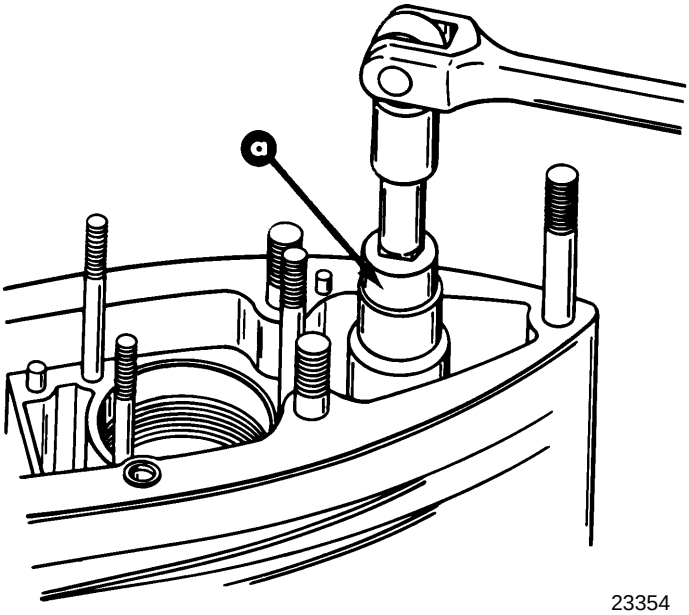
25. Remove shift shaft metal washer and rubber washer.



23354

a - Metal Washer and Rubber Washer (under metal washer)

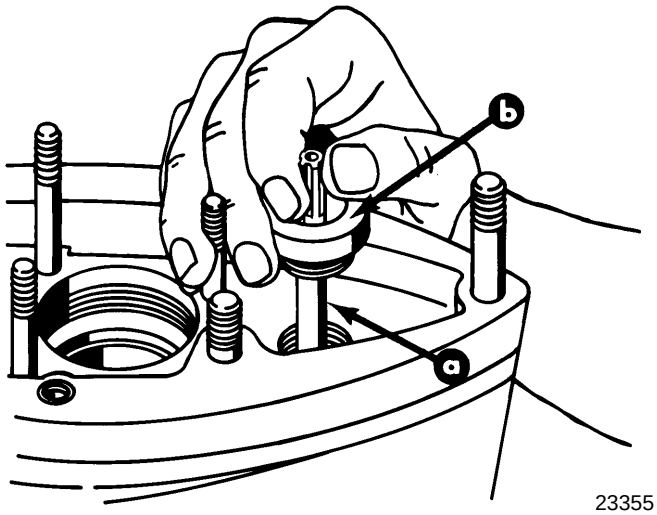
26. Loosen shift shaft bushing.



23354

a - Shift Shaft Bushing Tool (91-31107)

27. Lift shift shaft assembly and shift shaft bushing from gear housing. Remove shift crank from gear housing.



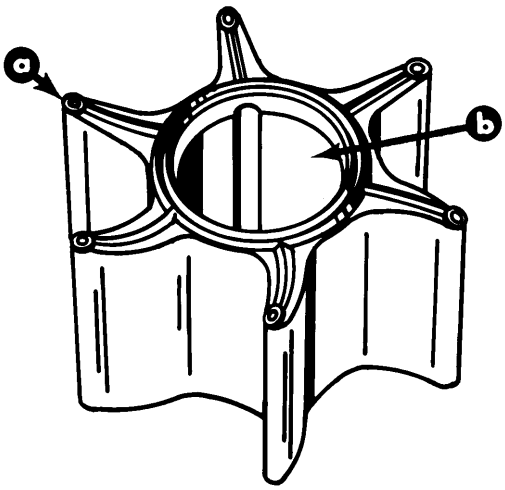
23355

a - Shift Shaft Assembly
b - Shift Shaft Bushing

Component Servicing

Water Pump Inspection

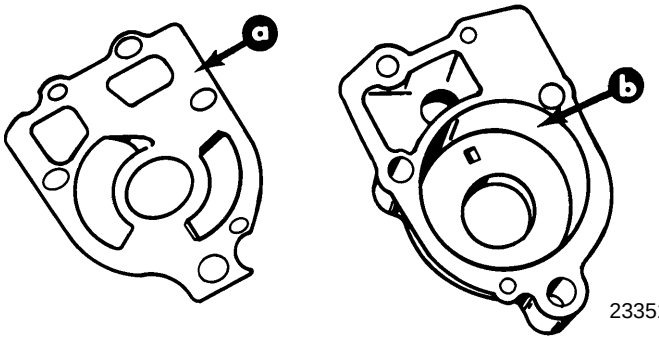
1. Check water pump impeller for wear on end of impeller blades and on top and bottom edge of blades.
2. Check for proper bonding between hub and impeller.
3. Replace impeller if blades have taken a set (hard and deformed) or have cracked.



50312

a - Water Pump Impeller
b - Hub (Changed From Aluminum To Fiber)

4. Inspect water pump face plate and insert for roughness and grooves.
5. Replace parts if defects are found.

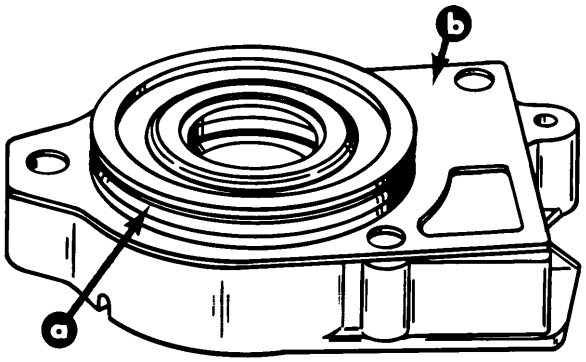


23351

a - Water Pump Face Plate
b - Insert

WATER PUMP DISASSEMBLY

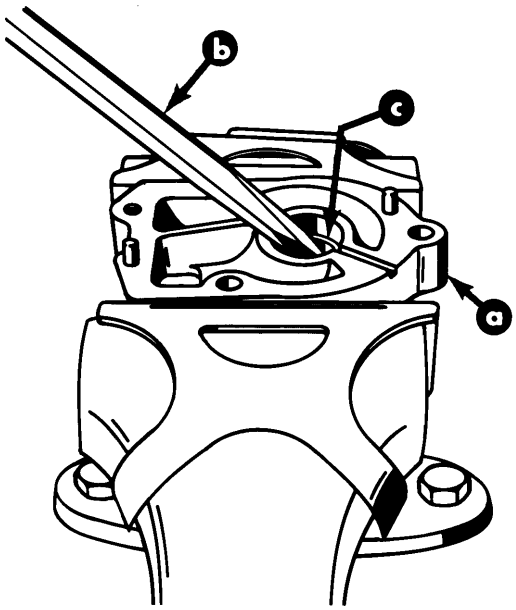
1. Remove water pump base O-ring and gasket.



23343

a - O-ring
b - Gasket

2. Remove water pump base oil seals.



23347

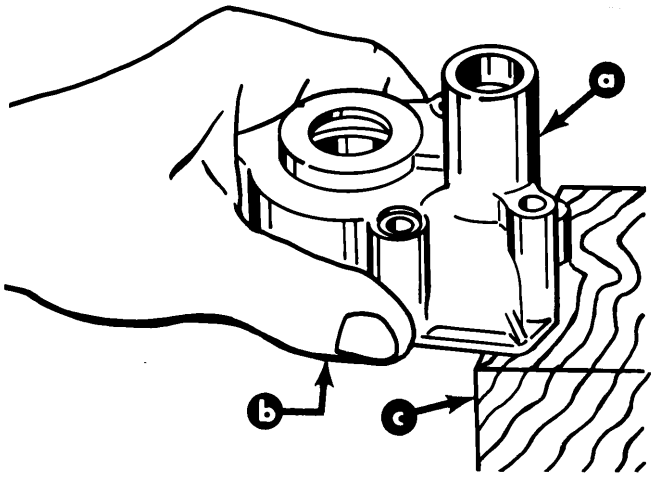
a - Water Pump Base
b - Screw Driver
c - Oil Seals (2) - Drive Out One At A Time

3. If water pump insert required replacement, follow Method “A” or “B” following.

NOTE: *Try Method “A” first. If insert cannot be removed following Method “A”, use Method “B”.*

METHOD “A”:

Hold firmly onto water pump body, remove insert by squarely and firmly tapping body on a hard surface.

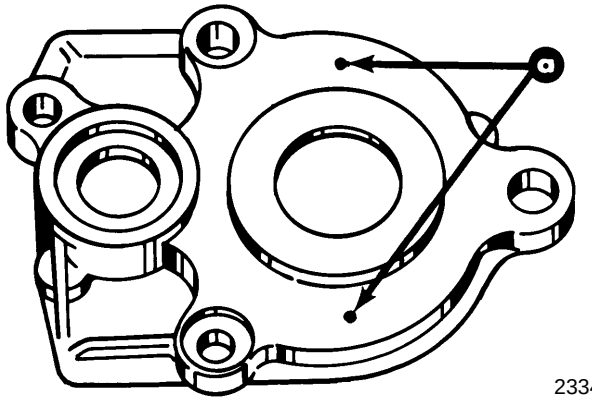


23355

a - Water Pump Body
b - Insert
c - Hard Surface (Wood Block)

METHOD “B”

Drill two 3/16 in. (5 mm) holes through water pump body. **DO NOT drill through insert.** Drive insert out of body, using punch and hammer.

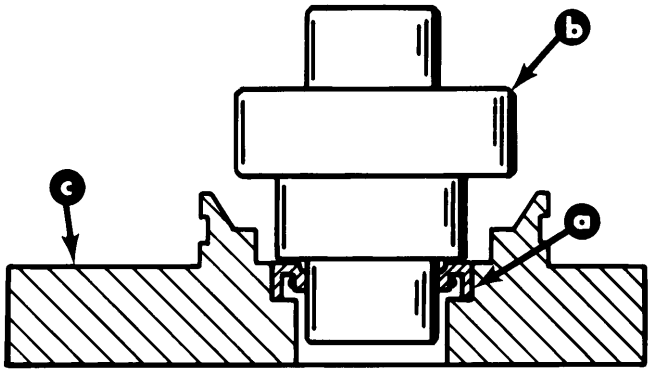


23349

a - 3/16in. (5 mm) Holes

Water Pump Reassembly

1. Coat O.D. of small seal with Loctite 27131. Press seal into water pump base from bottom, with lip of seal facing water pump base, using Oil Seal Driver (91-44110).

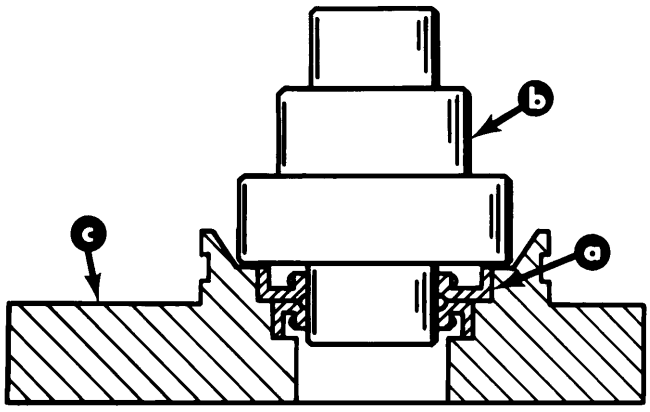


23139

a - Oil Seal
b - Oil Seal Driver (P/N 91-44110)
c - Water Pump Base

NOTE: *The O.D. of the large seal is coated with rubber. DO NOT use Loctite on this surface. Install this seal in a clean, dry bore.*

2. Press large seal into water pump base from bottom, with lip of seal facing bottom of water pump base, using Oil Seal Driver (91-44110). Fill area between two seals with 2-4-C Marine Lubricant.



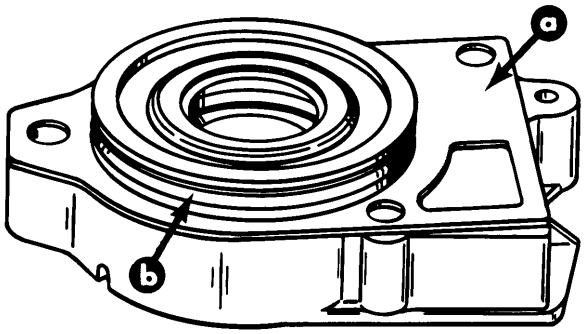
23139

a - Oil Seal
b - Oil Seal Driver (P/N 91-44110)
c - Water Pump Base

⚠CAUTION

Water pump base gasket MUST BE installed correctly. A gasket incorrectly installed will block water pump base water passage. A blocked water passage will result in subsequent engine overheating damage.

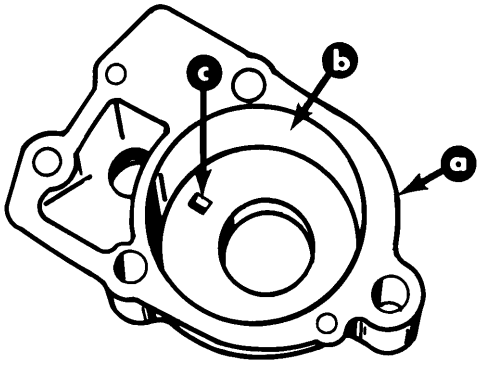
3. Install water pump base gasket and O-ring. Lubricate O-ring with 2-4-C Marine Lubricant.



23343

a - Gasket
b - O-ring

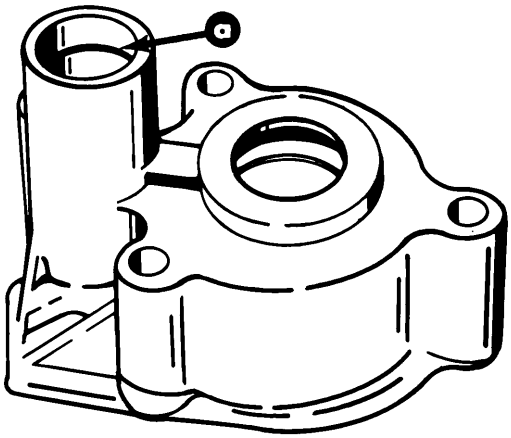
4. Install water pump insert into water pump as follows:
   a. Lubricate water pump insert outside diameter with Special Lubricant 101, 2-4-C Marine Lubricant.
   b. Install insert into water pump body. Make sure that tab on insert enters locating recess in pump body.



23351

a - Water Pump Body
b - Insert
c - Tab

5. Install water tube seal. Lubricate inside diameter with 2-4-C Marine Lubricant.



23351

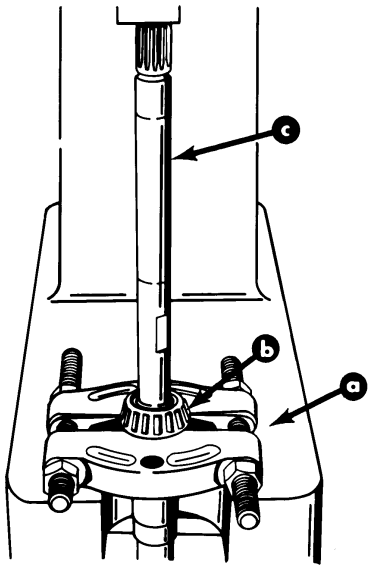
a - Water Tube Seal

Drive Shaft and Pinion Bearing Inspection and Cleaning

1. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.
2. The condition of the bearing surface on drive shaft at needle bearing location gives an indication of the condition of needle bearings. Replace needles and race as a set if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded particles.
3. Inspect splines for worn or twisted condition. Replacement of drive shaft is necessary if either condition exists.
4. Inspect pinion gear for pitting, chipped or broken teeth, fractures and excessive or uneven wear.
5. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

Drive Shaft Disassembly

1. Press tapered roller bearing from drive shaft using universal puller plate to support bearing (inner race).



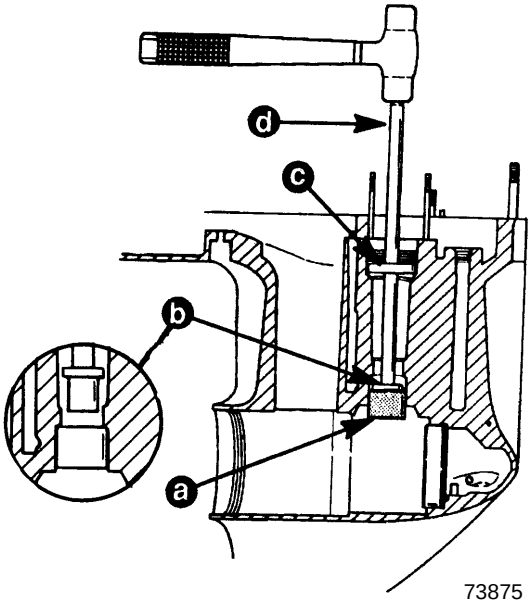
23349

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Drive Shaft

Pinion Bearing Removal

IMPORTANT: All needle bearings (18) MUST BE in place inside bearing race while driving pinion bearing from gear housing.

1. Remove pinion bearing using tools as shown.

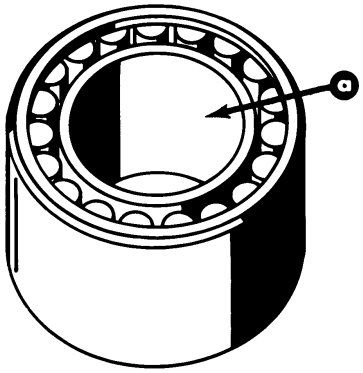


73875

a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

Pinion Bearing Installation

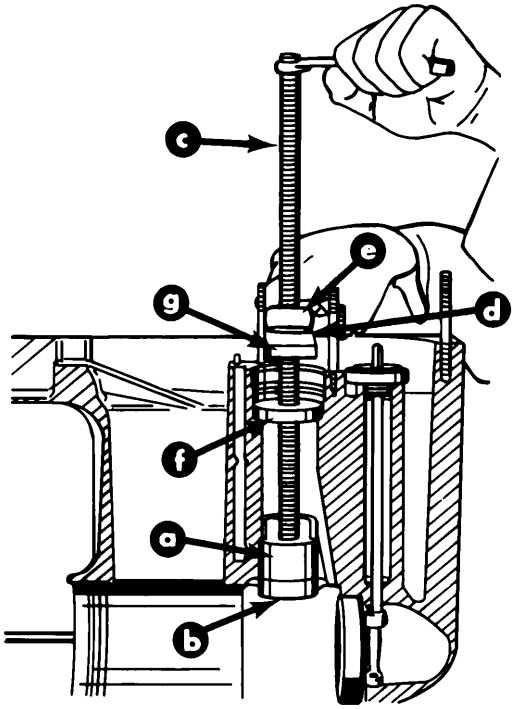
1. If needle bearings have fallen over in casing, install needles using Needle Bearing Assembly Lubricant (92-825265A1) to help hold needles in place. If new bearing is being installed, leave cardboard shipping sleeve in place until installed and ready to install drive shaft.



23351

a - Shipping Sleeve

2. Position bearing assembly over bearing installation tool, **with lettered and numbered side up**.
3. By way of propeller shaft cavity, place bearing into drive shaft bore.
4. Install bearing using tools as shown. Pull bearing up until it bottoms on shoulder inside bore.

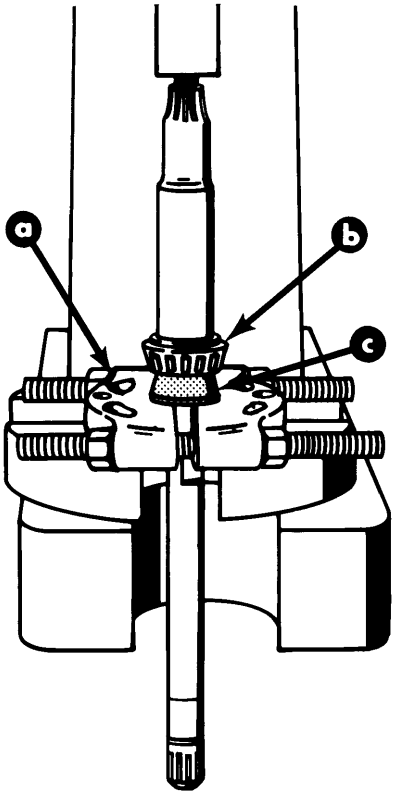


23350

a - Drive Shaft Pinion Bearing
b - Bearing Installation Tool (91-38628)
c - Puller Rod (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Plate (91-29310)

Drive Shaft Reassembly

1. Press tapered roller bearing onto drive shaft using universal puller plate and a suitable mandrel (old tapered roller bearing inner race). Ensure large O.D. faces pinion end of shaft.

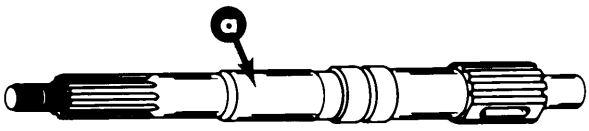


50314

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Suitable Mandrel

Bearing Carrier and Retainer Inspection

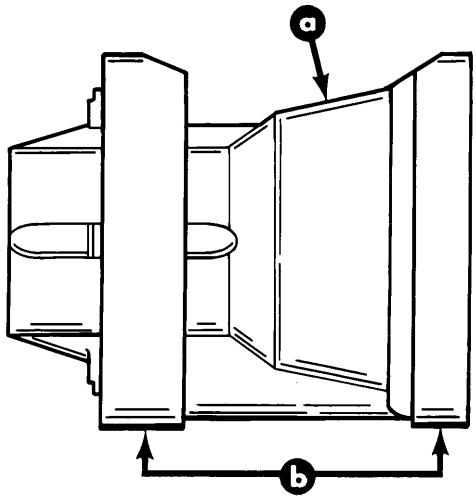
1. The condition of the propeller shaft bearing surface in the area of propeller shaft needle bearing is an indication of the condition of propeller shaft needle bearing. Replace bearing if surface is pitted, grooved, worn uneven, discolored from overheating or has embedded metal particles.



50698

a - Propeller Shaft Bearing Contact Area

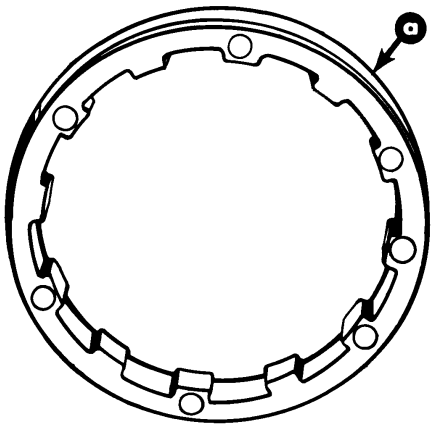
2. Check bearing carrier for signs of corrosion, especially in area where bearing carrier mates with gear housing. If corrosion is excessive, replace carrier.



50818

a - Bearing Carrier
b - Mating Surfaces

3. Inspect bearing carrier retainer for cracks and/or broken corroded threads.



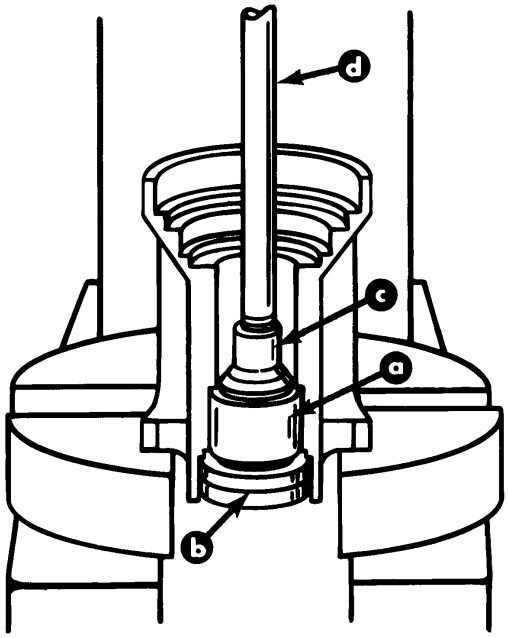
23356

a - Bearing Carrier Retainer

Bearing Carrier Disassembly

1. Perform Step a or b as necessary.

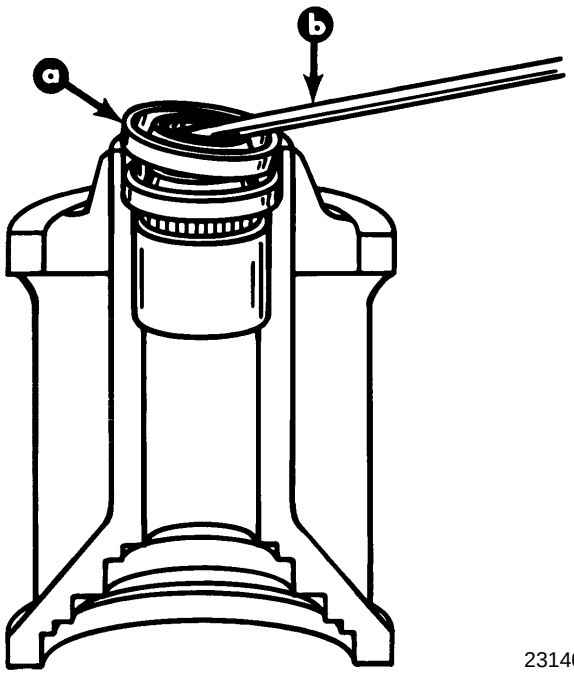
   a. **If Replacing Propeller Shaft Needle Bearing and Seals:** Remove needle bearing and seals with tools as shown.



23140

a - Needle Bearing
b - Oil Seals
c - Puller Head (91-36569)
d - Bearing Driver Rod (91-37323)

   b. **If Replacing Seals Only:** Remove oil seals. Be careful not to damage bore.

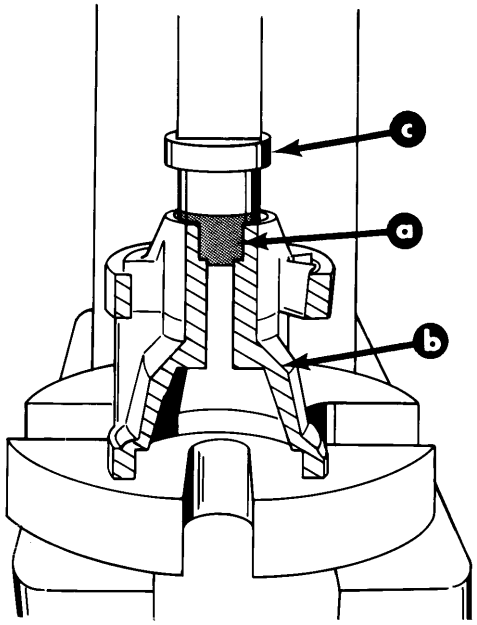


23140

a - Oil Seals
b - Pry Bar

Bearing Carrier Reassembly

1. Press needle bearing into bearing carrier until tool bottoms on bearing carrier. Ensure numbered side of needle bearing faces seal end of carrier.

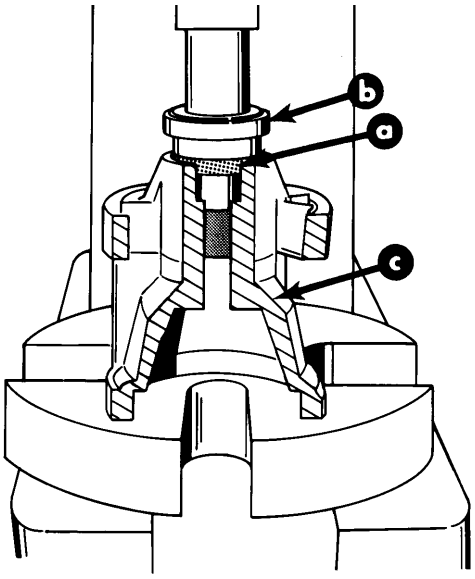


50788

a - Needle Bearing
b - Bearing Carrier
c - Bearing Driver (91-15755)

NOTE: *If first oil seal has a rubber covered O.D., DO NOT apply Loctite in the following step. Seal must be installed in a clean, dry bore.*

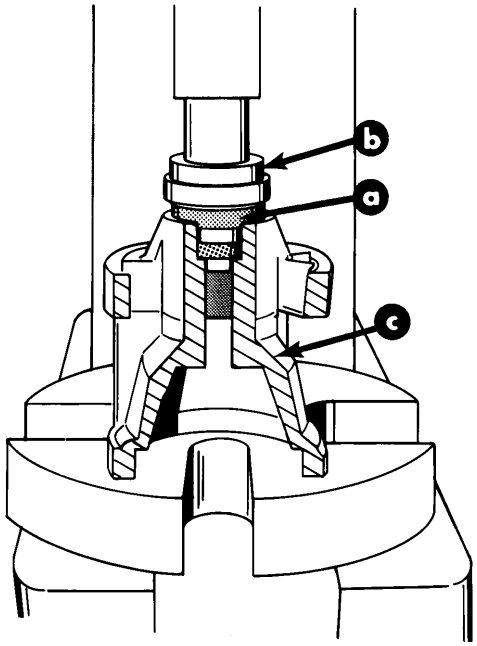
2. Apply Loctite 27131 or Type "A" to outside diameter of first propeller shaft oil seal. Install seal with lip facing needle bearing. Press oil seal with tool until tool bottoms on bearing carrier.



50788

a - Oil Seal
b - Oil Seal Driver (91-31108)
c - Bearing Carrier

3. Apply Loctite 27131 to outside diameter of second propeller shaft oil seal. Install seal with lip facing away from needle bearing. Press oil seal with tool until tool bottoms on bearing carrier.

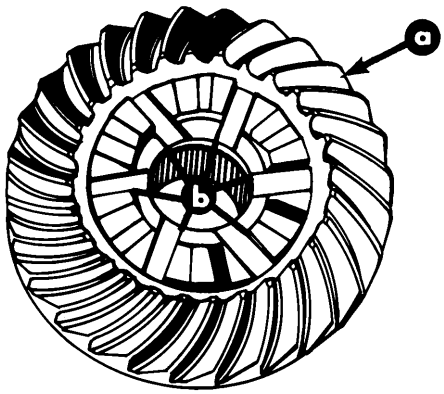


50788

a - Oil Seal (Fishing Line Cutter)
b - Oil Seal Driver (91-31108)
c - Bearing Carrier

Forward Gear Inspection

1. Inspect forward gear for pitting, chipped or broken teeth, fracturing and excessive or uneven wear.
2. Check forward gear clutch jaws for damage. Jaws must not be chipped or rounded off.

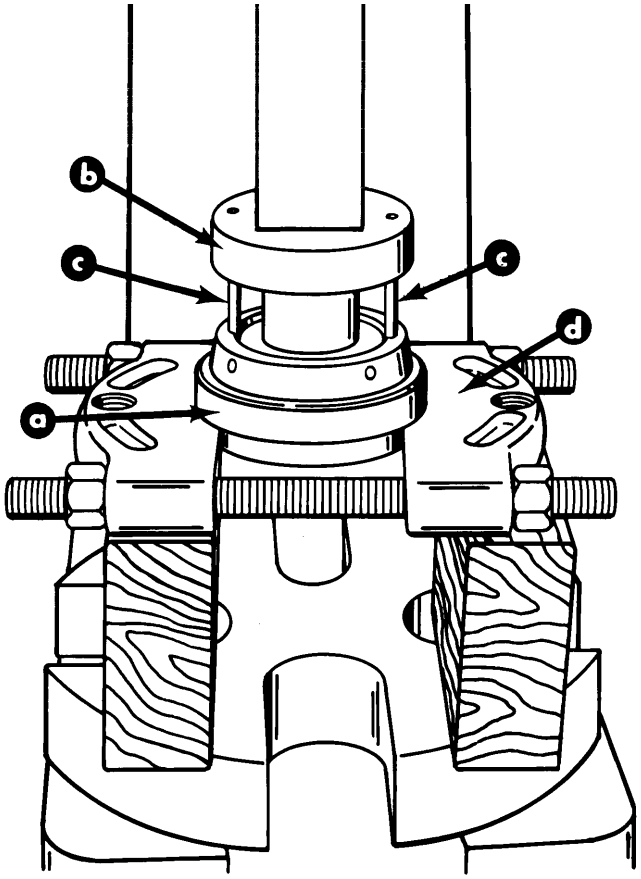


23351

a - Forward Gear Teeth
b - Clutch Jaws

Forward Gear Bearing Adaptor Disassembly and Inspection

1. Inspect bearing and race for pitting and scoring and any other visible signs of damage. Replace if damaged.
2. Inspect bearing adaptor for damage. Ensure thrust bearing race contact surface is smooth and free of nicks.
3. Remove bearing from adaptor using Bearing Removal Tool (91-816245). Apply pressure to center of tool so that pressure is equal on pins.

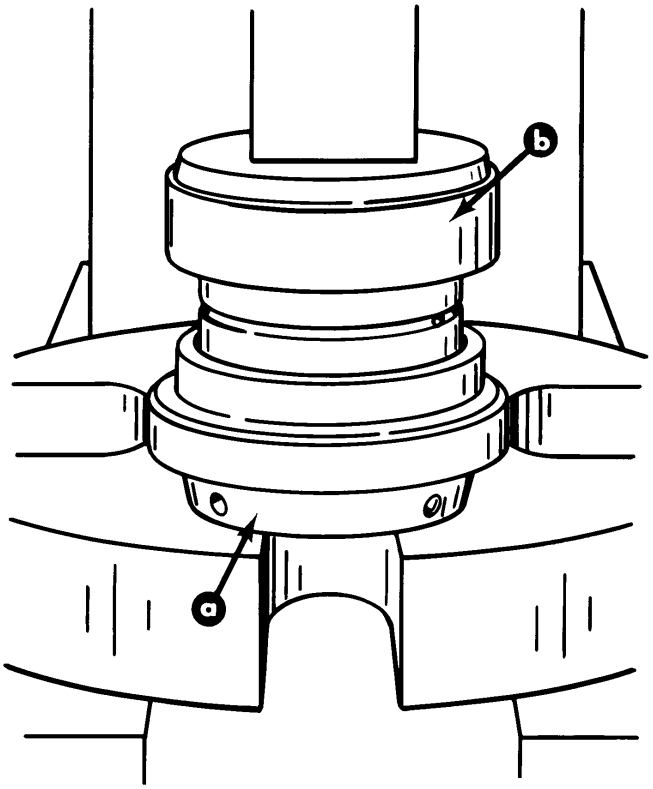


50874

a - Forward Gear Bearing Adaptor
b - Special Tool
c - Pins
d - Universal Puller Plate

Forward Gear Bearing Adaptor Reassembly

1. Apply a light coat of Special Lubricant 101 to bearing adaptor I.D. before installing bearing.
2. Press roller bearing into bearing adaptor using a suitable mandrel until bearing bottoms in adaptor.

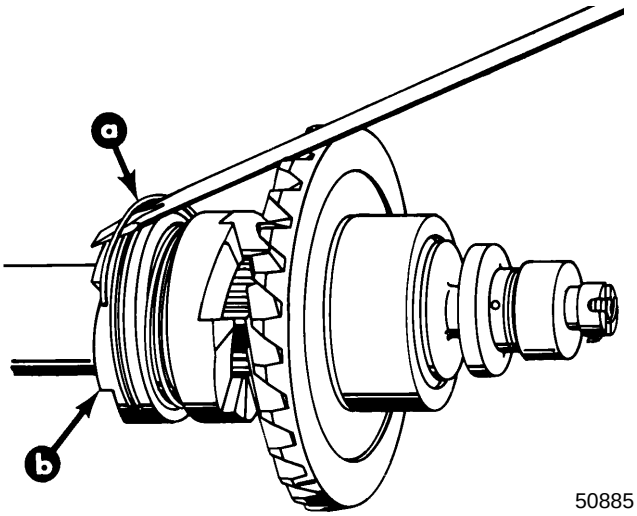


50783

a - Bearing Adaptor
b - Mandrel

Propeller Shaft, Reverse Gear and Shift Spool Disassembly

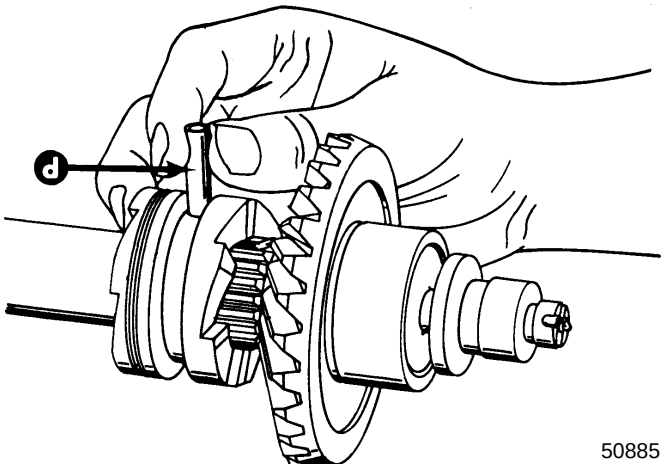
1. Remove spring from clutch.



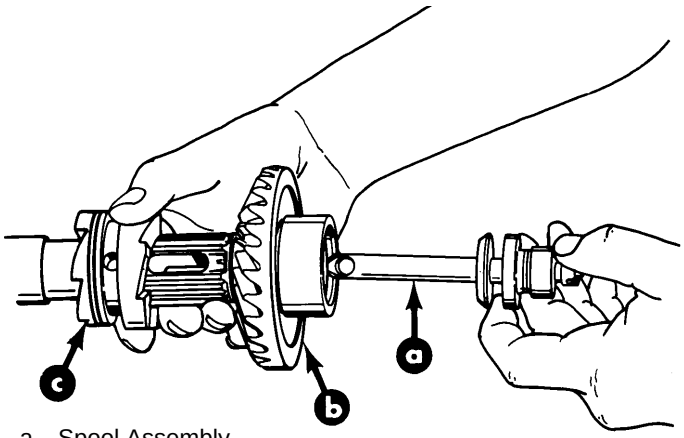
50885

a - Spring
b - Clutch

2. Remove pin from clutch, slide spool assembly out of propeller shaft, remove reverse gear and slide clutch off of propeller shaft.



50885

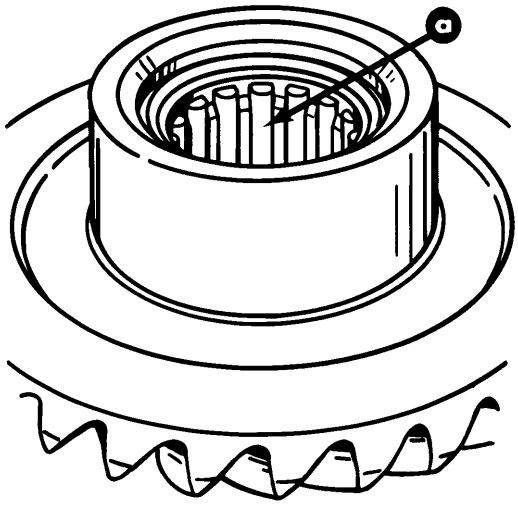


a - Spool Assembly
b - Reverse Gear
c - Clutch
d - Pin

50881

NOTE: *Roller bearing should not be removed unless damage is suspected. Ensure all rollers are in place. Rollers may be snapped back into place if dislodged, as long as rollers or bearing cage is not damaged.*

3. Press out reverse gear roller bearing using a suitable mandrel.

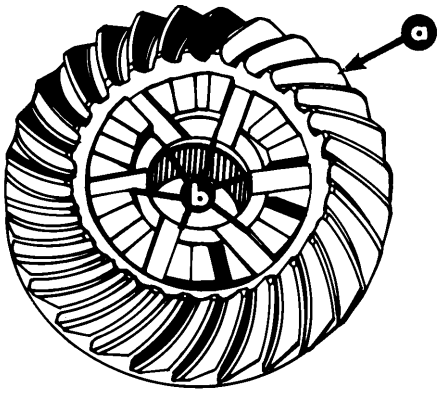


50778

a - Needle Bearing

Propeller Shaft, Reverse Gear and Bearing and Shift Spool Assembly Inspection and Cleaning

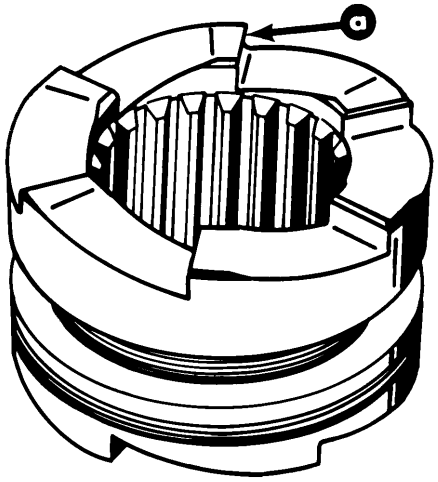
1. Inspect reverse gear for pitting, chipped or broken teeth, fracturing and excessive or uneven wear.
2. Check reverse gear clutch jaws for damage. Jaws must not be chipped or rounded-off.



23351

a - Gear Teeth
b - Clutch Jaws

3. Check sliding clutch engaging jaws for damage. Jaws must not be chipped or rounded off.



23350

a - Sliding Clutch Engaging Jaws

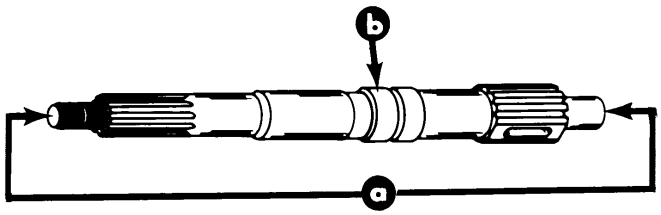
4. Check propeller shaft for bent condition. Use either method following:

LATHE AND DIAL INDICATOR

a. Position propeller shaft centers in lathe.

b. Mount dial indicator just forward of propeller shaft splines.

c. Rotate shift and observe dial indicator movement. Movement of more than .007 in. (0.17 mm) is reason for replacement.



50698

a - Propeller Shaft Centers
b - Mount Dial Indicator Here

V-BLOCKS AND DIAL INDICATOR

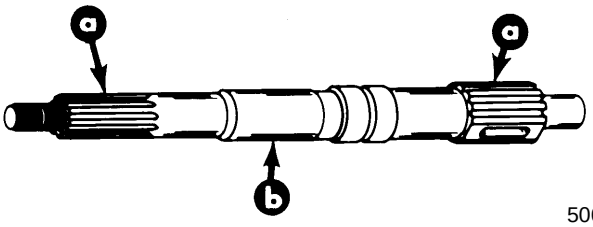
NOTE: *Be sure to adjust V-blocks to compensate for propeller shaft bearing surface diameters.*

a. Position propeller shaft bearing surfaces on V-blocks.

b. Mount dial indicator just forward of propeller shaft splines.

c. Rotate shaft and observe dial indicator movement. Movement of more than .007 in. (0.17 mm) is reason for replacement.

5. Inspect propeller shaft for broken or twisted splines. Replace shaft if any damage is detected on the sliding clutch splines. Minor twisting on propeller end of shaft is acceptable as long as there are no fractures. If there is any doubt as to the condition of the propeller shaft, replace it.
6. Inspect surface of propeller shaft where bearing carrier oil seals lips contact shaft. If oil seals have made grooves, propeller shaft must be replaced.



50698

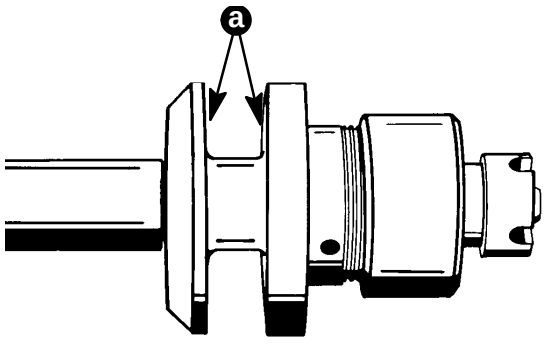
a - Propeller Shaft Splines
b - Oil Seal Contact Area

7. Clean all component parts (except new bearings) with cleaning solvent. Dry components thoroughly with compressed air, being careful not to spin bearings.

8. Clean the shift spool assembly with a suitable solvent and dry the parts thoroughly using compressed air.

9. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair, it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.

10. Inspect the shift spool for wear in the area where the shift crank comes into contact.

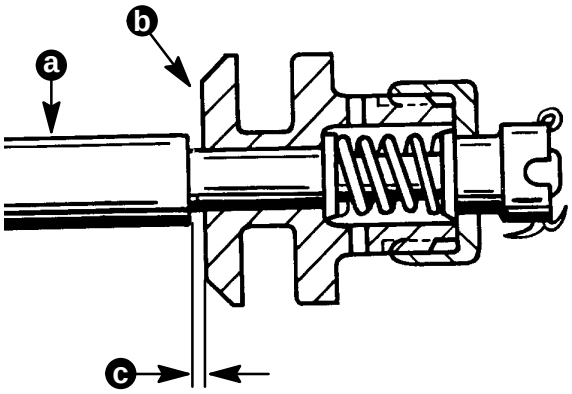


23356

a - Contact Area

11. Ensure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).

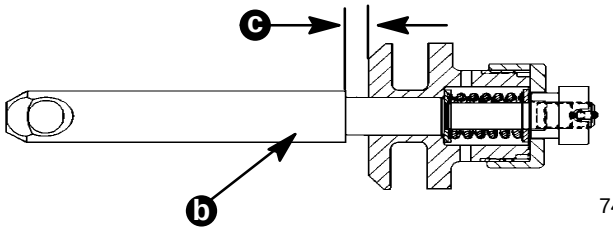
12. Ensure that the spool has no more than .002-.010 (0.051-0.254 mm) end play.



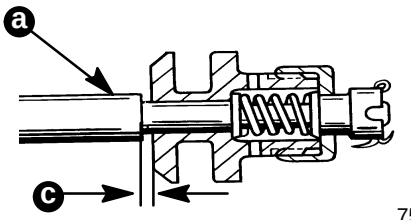
74877

a - Shift Shaft
b - Spool
c - Gap Has Increased - End Play Measurement: .002 - .010 in. (0.051 - 0.254 mm) Is Same As Earlier Models

NOTE: *The later style shift spool assembly for the counter rotation has a larger gap than the earlier style. This later style shift spool, beginning with serial number OF726586, is sold as a whole assembly and must be used when replacing the earlier style (Prior to S/N OF726586).*



74877

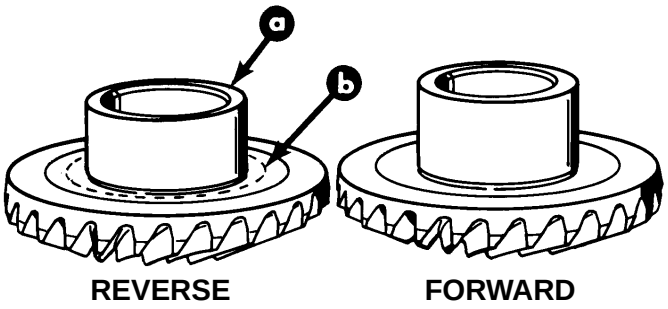


75219

a - Earlier Style Shift Spool Assembly (Prior To S/N OF726586)
b - Later Style Shift Spool Assembly (S/N OF726586 And Above)
c - Measure End Play Here At Gap

Propeller Shaft, Reverse Gear and Shift Spool Reassembly

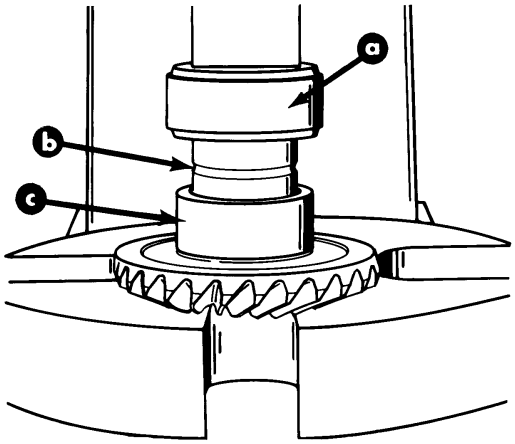
IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between reverse and forward gears. Reverse gear has a shorter hub and it has a groove cut into the back of the gear, just inside the thrust bearing race surface.



50885

a - Shorter Hub
b - Groove

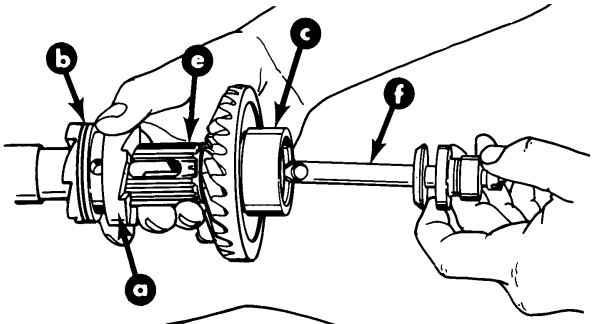
1. Apply a light coat of Special Lubricant 101 to bore of reverse gear.
2. Press needle bearing into reverse gear using Bearing Driver (91-816244) from hub side of gear until tool bottoms on hub.



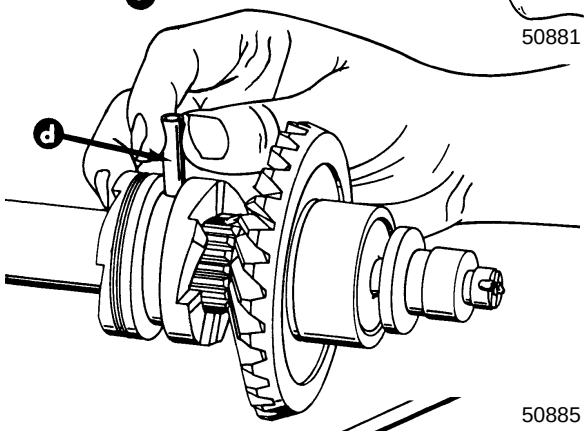
50789

a - Bearing Driver
b - Needle Bearing
c - Hub

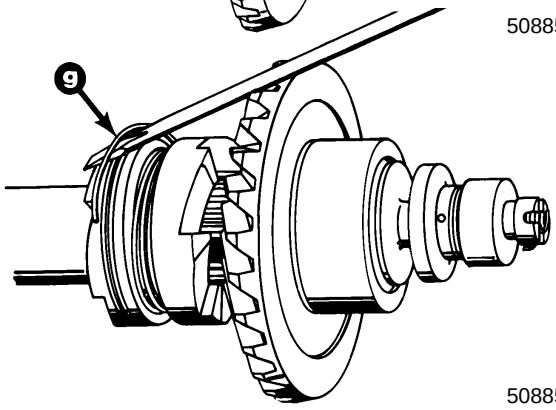
3. Assemble propeller shaft, reverse gear and shift assembly as follows:
   a. Install sliding clutch on propeller shaft, being sure to align cross pin holes in clutch with slot in propeller shaft. Make sure sliding clutch is placed on propeller shaft with grooved end of clutch facing propeller end of shaft.
   b. Install reverse gear.
   c. Install shift spool and actuating shaft assembly.
   d. Install cross pin through sliding clutch, propeller shaft and actuating shaft.
   e. Install retainer spring to cover cross pin hole. Ensure retainer spring coils do not overlap.



50881



50885

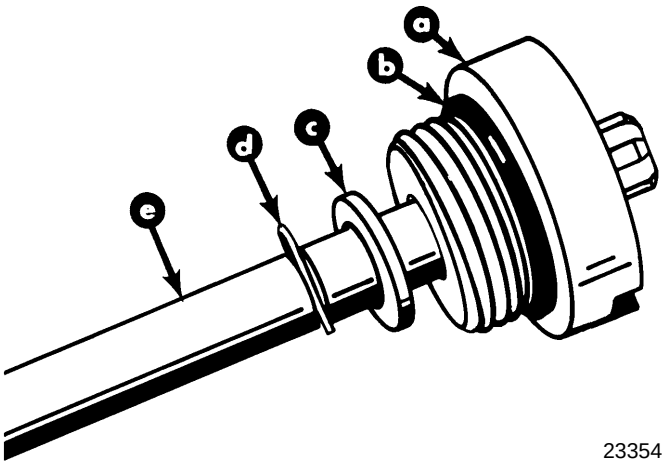


50885

a - Sliding Clutch
b - Grooves In Clutch
c - Reverse Gear Assembly
d - Cross Pin
e - Propeller Shaft
f - Spool And Actuating Shaft Assembly
g - Cross Pin Retainer Spring

Shift Shaft Disassembly

1. Remove shift shaft components as shown.



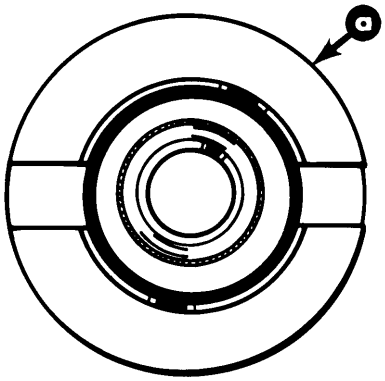
23354

a - Shift Shaft Bushing
b - O-ring
c - Washer
d - Clip
e - Shift Shaft

Shift Shaft Inspection and Cleaning

NOTE: *If oil seal in shift shaft bushing is found to be defective, oil seal and shift shaft bushing must be replaced as an assembly.*

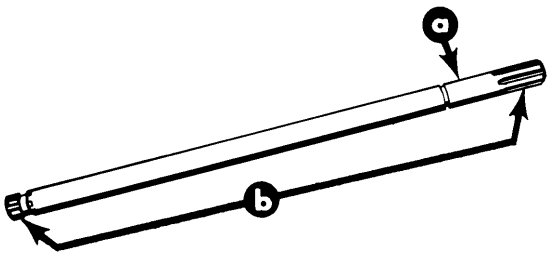
1. Inspect shift shaft bushing for corrosion in seal area. Replace if damaged.



23349

a - Shift Shaft Bushing

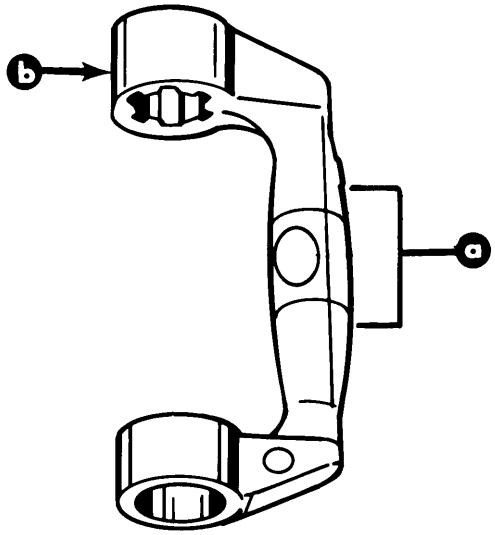
2. Inspect shift shaft splines and seal surface for corrosion. Ensure splines are not twisted.



23355

a - Seal Surface
b - Splines

3. Inspect shift crank for excessive wear in area that contacts shift spool. Replace if necessary.

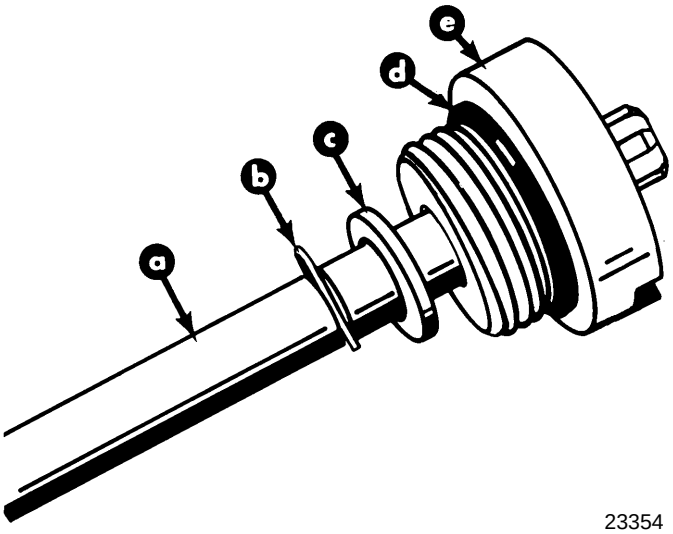


23350

a - Contact Area
b - Shift Crank

Shift Shaft Reassembly

1. Reassemble shift shaft components in order shown.

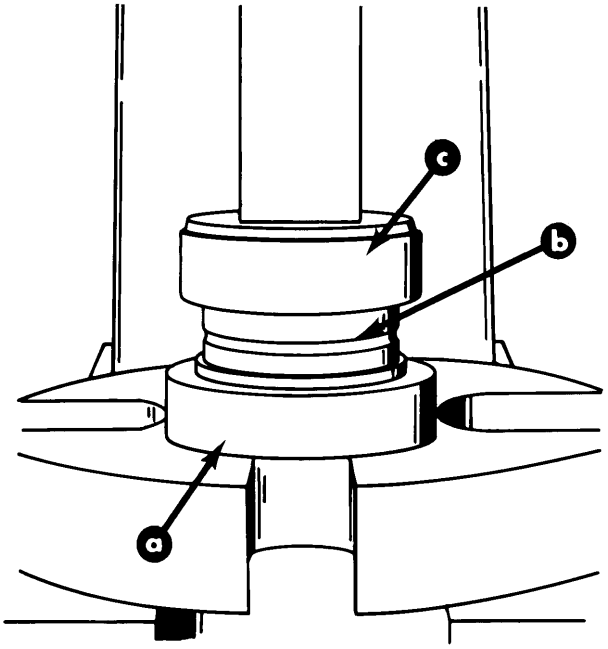


23354

a - Shift Shaft
b - Clip
c - Washer
d - O-ring
e - Shift Shaft Bushing (Seal Inside)

Reverse Gear Bearing Adaptor Roller Bearing Replacement

1. Press needle bearing from bearing adaptor using a suitable mandrel.
2. Inspect bearing and adaptor for damage and replace if necessary.
3. Apply a light coat of Special Lubricant 101 to bearing adaptor bore.
4. Press bearing into stepped side of adaptor until flush with top of lip, using a suitable mandrel.



50790

a - Bearing Adaptor
b - Bearing
c - Mandrel

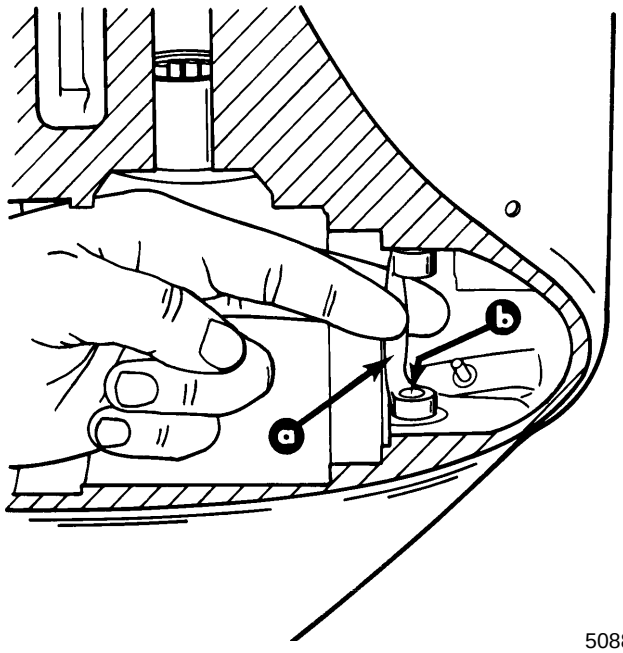
Gear Housing Cleaning and Inspection

1. Check gear housing carefully for impact damage.
2. Inspect bearing carrier retainer threads, in gear housing for corrosion or stripped threads. Clean with hard bristle brush.
3. Inspect reverse gear bearing adaptor contact area for evidence of spinning. Check that bearing adaptor is not loose in bearing bore.
4. Inspect for blockage in water inlet holes. Clean if necessary.
5. Make sure that locating pins are in place in gear housing and that corresponding holes in drive shaft housing are not elongated. Drive shaft may break if housings are not aligned properly.

Gear Housing Shimming

Shift Shaft Installation

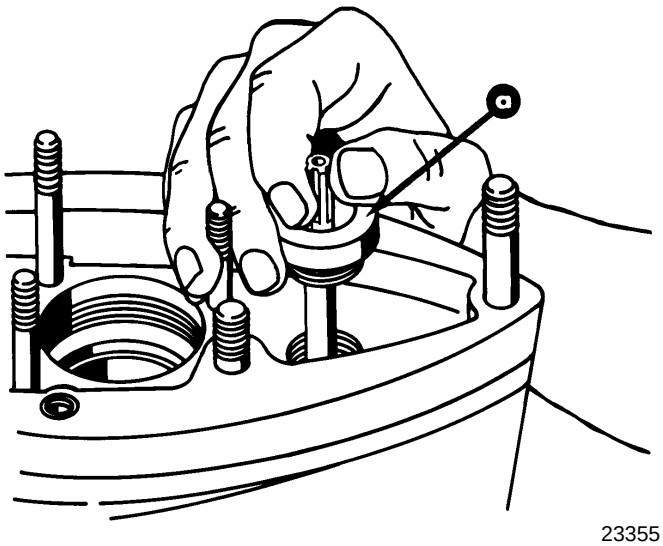
1. Place shift crank on locating pin in forward section of gear housing. Ensure shift crank faces toward left (port) side of gear housing.



50887

a - Shift Crank
b - Locating Pin

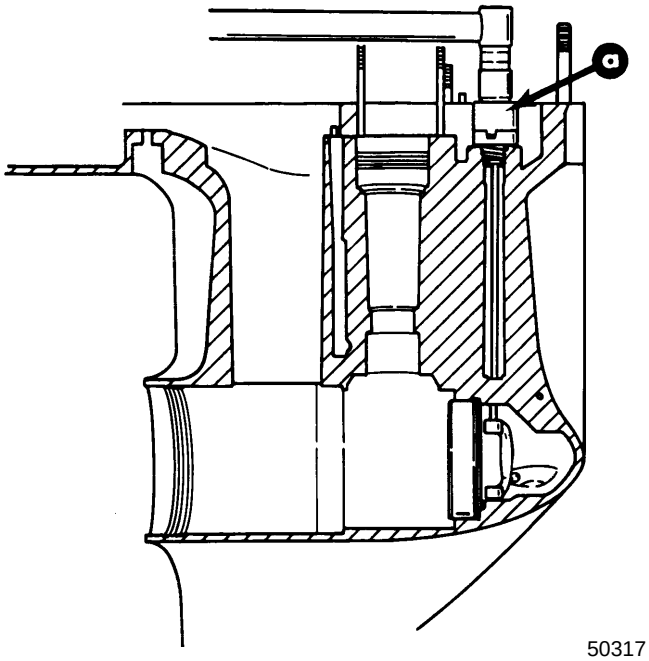
2. Apply Special Lubricant 101 to shift shaft and bushing threads. Install shift shaft assembly into gear housing as shown. Ensure that lower splined end of shift shaft is engaged with shift crank.



23355

a - Shift Shaft Assembly

3. Coat threads of bushing with Perfect Seal and thread shift shaft bushing into gear housing. Torque to 50 lb. ft. (68 N·m) using shift shaft bushing tool.

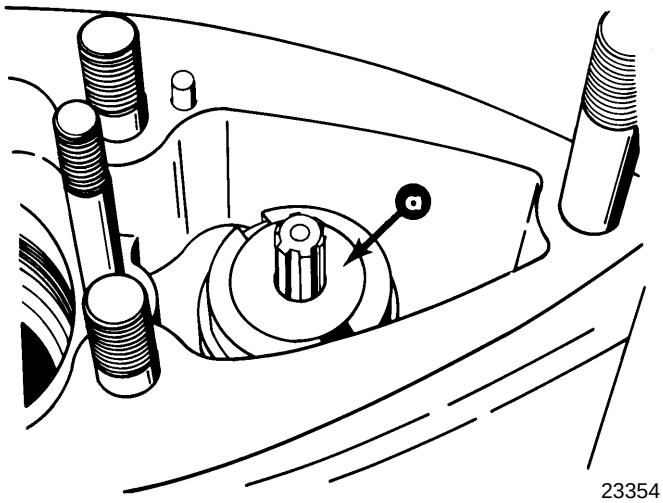


a - Shift Shaft Bushing Tool (91-31107)

⚠ WARNING

Failure to install the stainless steel washer over shift shaft bushing could allow intermediate shift shaft to drop down during operation and prevent shifting of the drive unit.

4. Install rubber washer over shift shaft and seat in bushing. Apply Special Lubricant 101 to stainless steel washer to stick it in place over rubber washer.

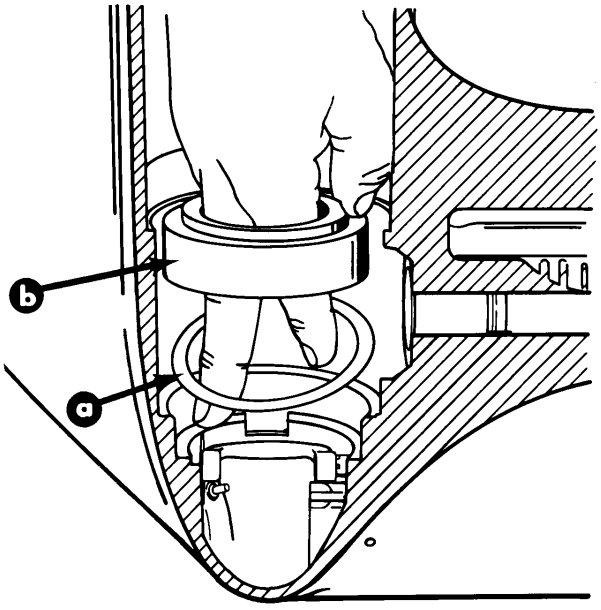


a - Stainless Steel Washer (Rubber Washer Beneath)

Reverse Gear Bearing Adaptor Installation

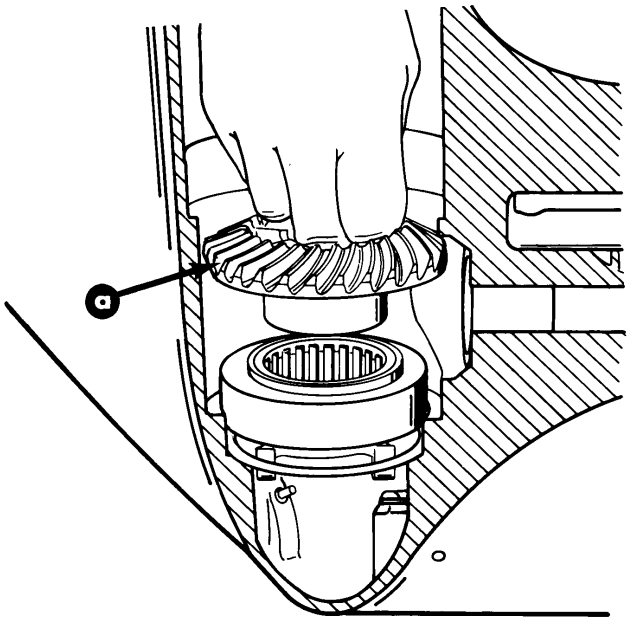
NOTE: *Start out using the existing shims if reusing the gear housing and bearing adaptor. If original shim thickness is unknown or if replacing the gear housing or adaptor, start with .008 in. (0.20 mm) of shims.*

1. Lubricate bearing adaptor O.D. with Special Lubricant 101.
2. Position appropriate shims and bearing adaptor in gear housing.



a - Shims
b - Bearing Adaptor

3. Place reverse gear (without thrust race or thrust bearing) into bearing adaptor.



a - Reverse Gear

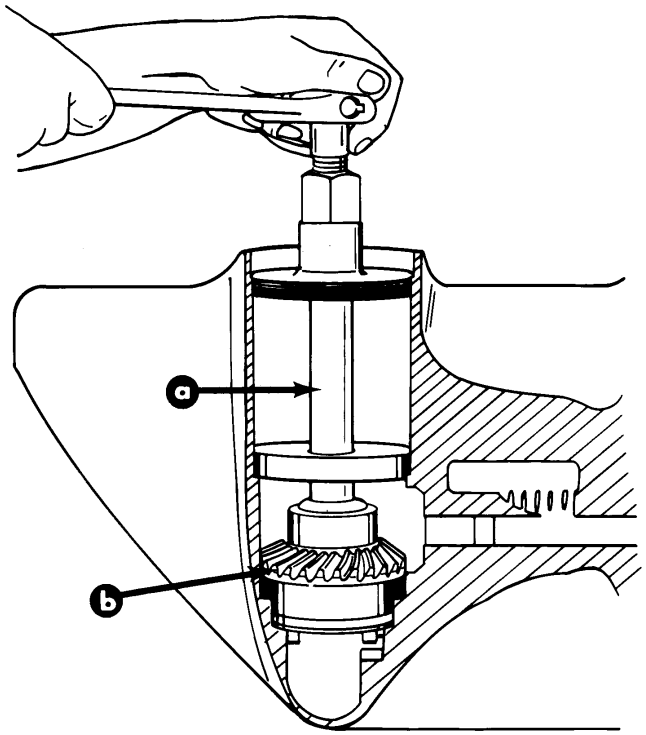
4. Press bearing adaptor into gear housing using Installation Tool (91-18605A2) as follows:

IMPORTANT: Be sure that bearing adaptor is positioned as straight as possible to avoid cocking it in bore while pressing it in.

a. Lubricate threads of tool and install in gear housing. Tighten until one or two threads are visible.

b. Turn hex-head screw until bearing adaptor bottoms. DO NOT apply pressure once screw stops.

c. Remove tool assembly **and reverse gear.**



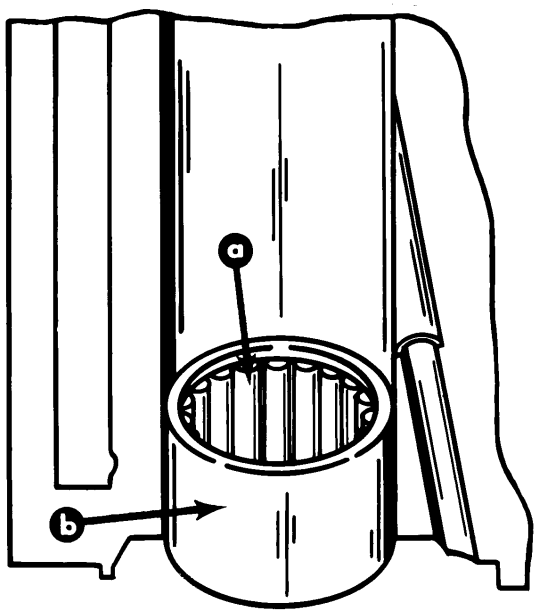
50791

a - Installation Tool
b - Reverse Gear

Drive Shaft and Pinion Gear Installation (Without Propeller Shaft in Place)

IMPORTANT: If unit does not require reshimming (no parts were replaced), proceed to Propeller Shaft and Reverse Gear Installation. If pinion height must be checked, proceed as follows.

1. If pinion bearing was not replaced, but needle bearings have fallen out during disassembly, install 18 needles in needle bearing outer race. Use needle bearing assembly lubricant to help hold needles in place.

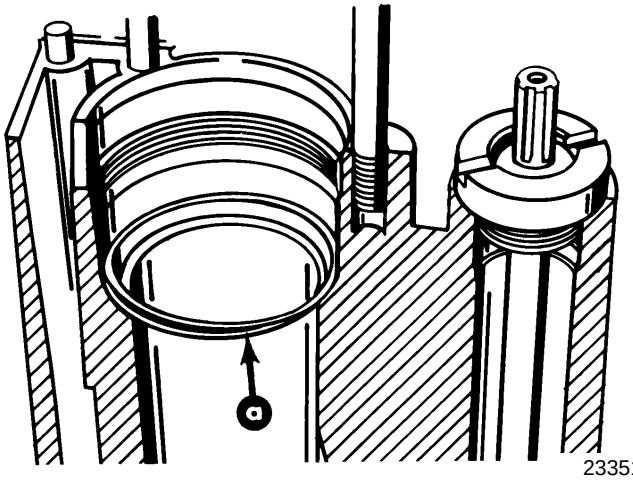


23142

a - Rollers (18) - Hold In Place Using Needle Bearing Assembly Lubricant (92-42649A1)
b - Roller Bearing Outer Race

NOTE: *If shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing or gear housing were replaced, start off by installing .020 in. of shims.*

2. Place shim(s) in drive shaft housing bore.

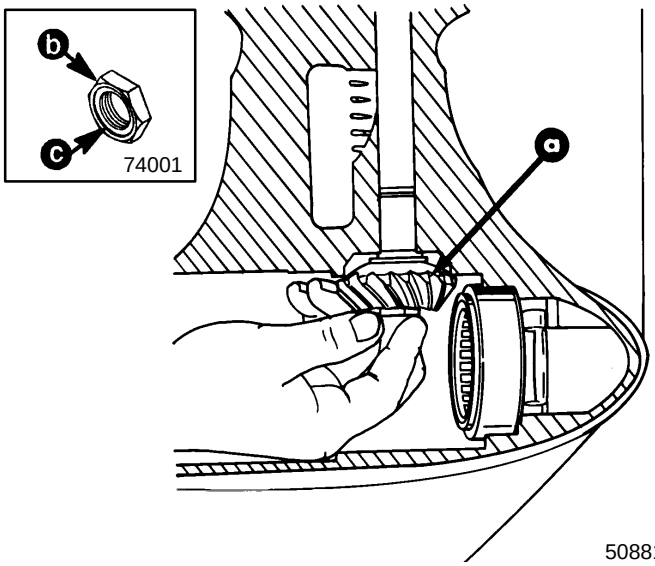


23351

a - Shim(s)

NOTE: *For ease of installation, glue washer to pinion gear, using 3M Adhesive (92-86166-1) or equivalent.*

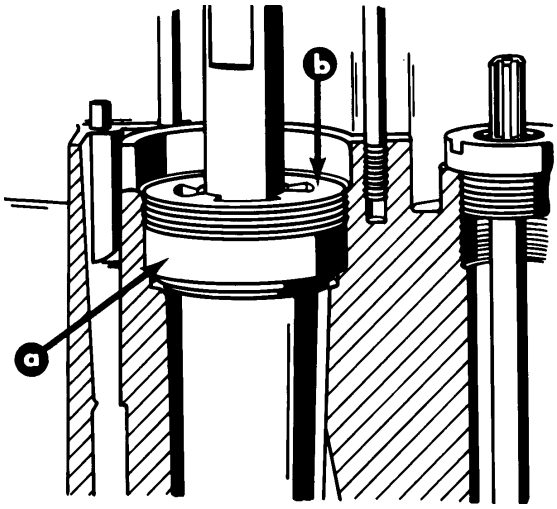
3. Install drive shaft and pinion gear as follows:
   a. Place pinion gear and washer in gear housing.
   b. Insert drive shaft into gear housing bore. Rotate drive shaft to engage drive shaft splines with pinion gear splines.
   c. Hand thread nut onto drive shaft. DO NOT tighten further at this time. Install pinion nut with the machined shoulder against the pinion gear. If both sides of the nut have a machined shoulder, then either shoulder may be placed against the pinion gear.



50881

a - Pinion Gear, Nut and Washer
b - Pinion Nut
c - Shoulder

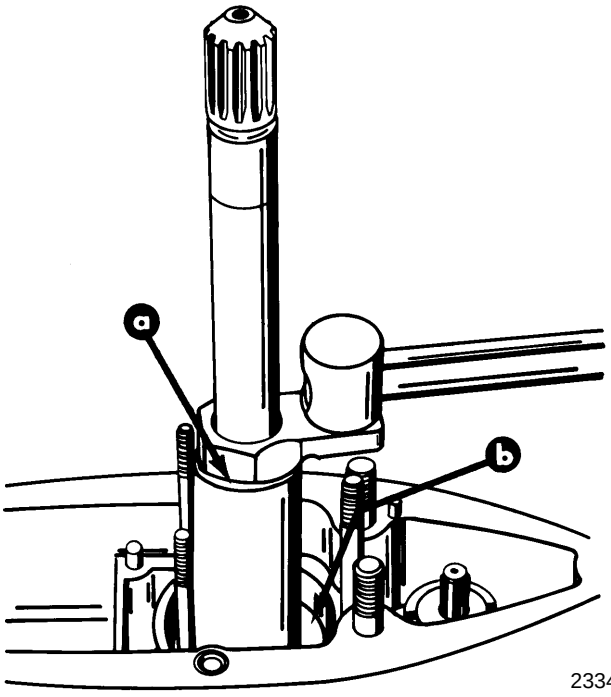
4. Lubricate threads of retainer with Special Lubricant 101 and install bearing cup and retainer.



23352

a - Bearing Cup
b - Retainer

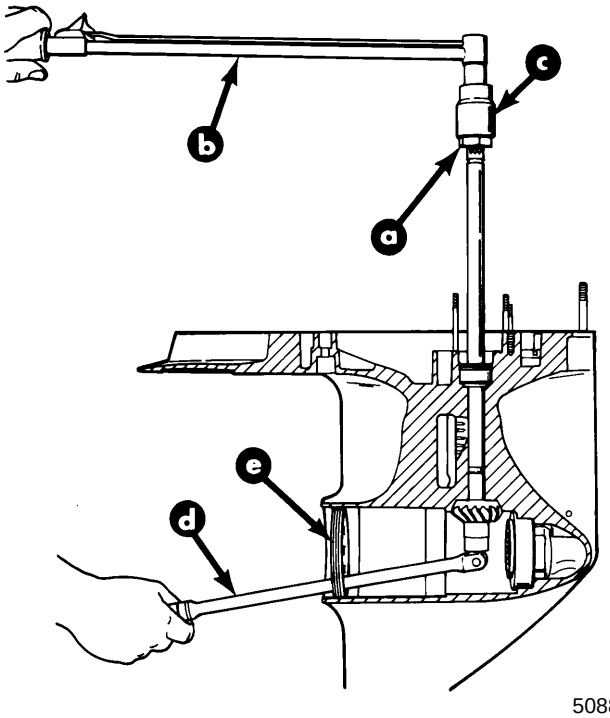
5. Torque retainer using Drive Shaft Bearing Retainer Tool (91-43506) to 100 lb. ft. (130 N·m).



23348

a - Drive Shaft Bearing Retainer Tool (P/N 91-43506)
b - Retainer

6. Partially install bearing carrier retainer nut (to protect threads) and torque pinion nut to 60-80 lb. ft. (81-108 N·m).



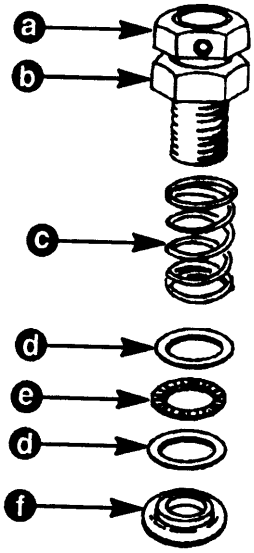
50882

a - Drive Shaft Nut Wrench (91-56775)
b - Torque Wrench
c - Socket
d - Breaker Bar
e - Bearing Carrier Retainer

CHECKING PINION GEAR HEIGHT

Current Style Preload Tool Installation

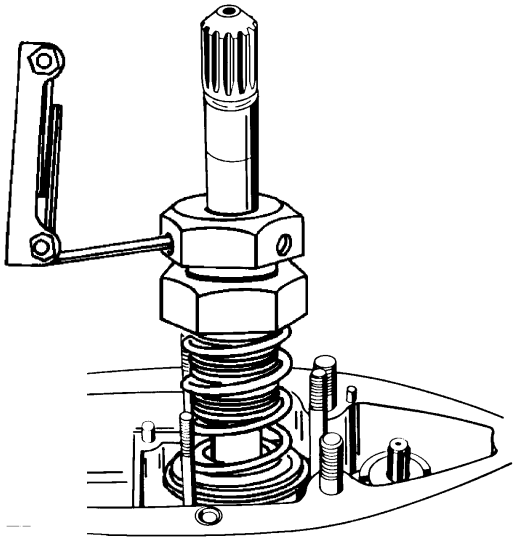
1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.



75750

a - Top Nut With Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer

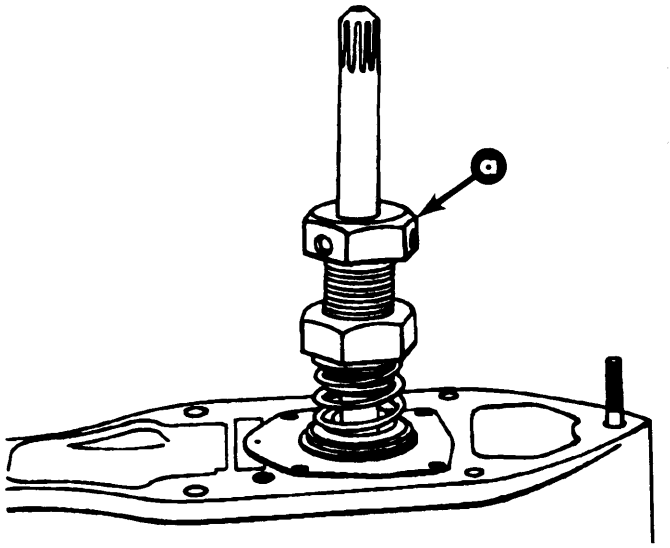
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



75733

a - Allen Screws

3. Screw the bottom nut of the bearing preload tool down until it is one inch further down the threaded rod than it was previously.



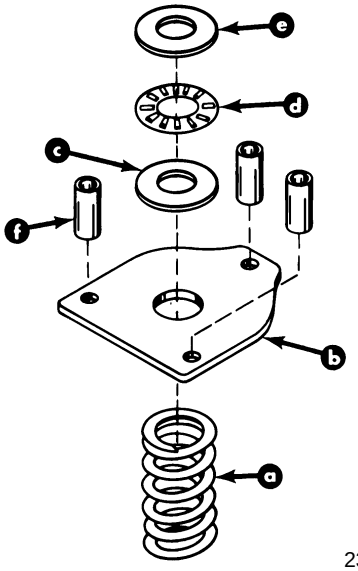
71591

a - Bottom Nut [Screwed Down Approximately 1 In. (25 mm) Further Than It Was Previously]

4. Rotate the drive shaft at least three full turns in a clockwise direction.

Early Style Preload Tool Installation

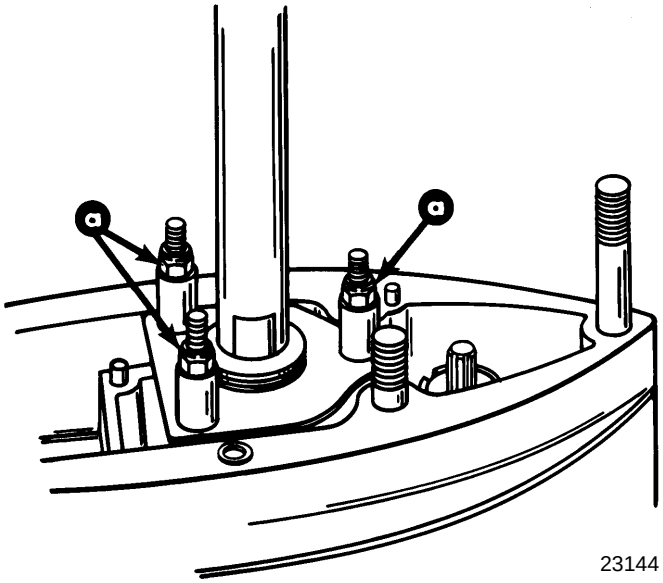
1. Install the components from Bearing Preload Tool (91-14311A2) over drive shaft in order shown.



23144

a - Spring
b - Plate
c - Washer
d - Bearing
e - Washer
f - Spacers(3)

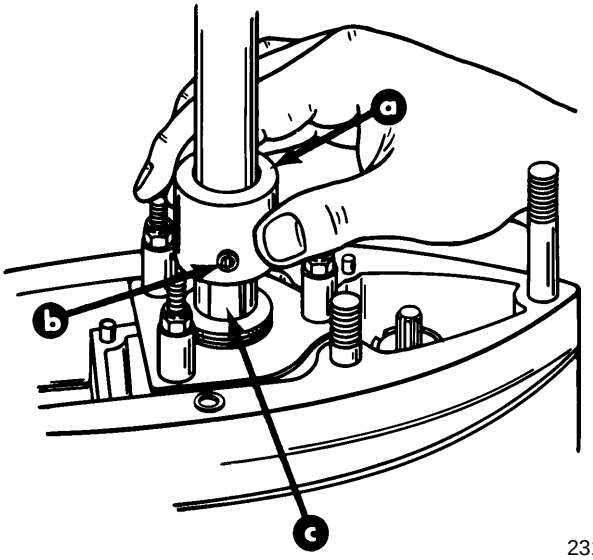
2. Install and tighten nuts until they just bottom on spacers.



23144

a - Nuts (3)

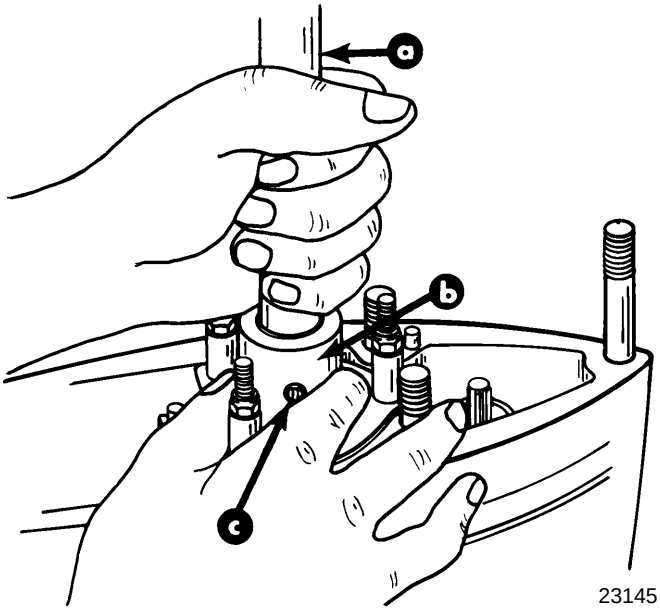
3. Place collar from Bearing Preload Tool (91-14311A2) over drive shaft with set screw down. Align set screw with flat on drive shaft.



23145

a - Collar
b - Set Screw
c - Flat on Drive Shaft

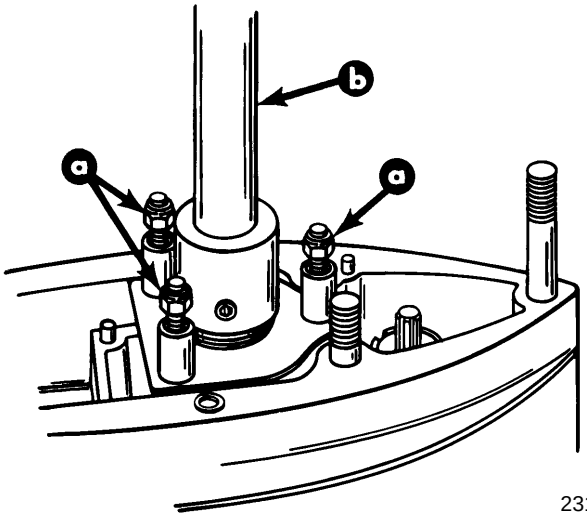
4. Pull up on drive shaft, push down on collar and tighten set screw.



23145

a - Drive Shaft
b - Collar
c - Set Screw

5. Loosen nuts 3-4 turns and then rotate drive shaft clockwise 2 or more turns to seat bearings.



23146

a - Nuts
b - Drive Shaft

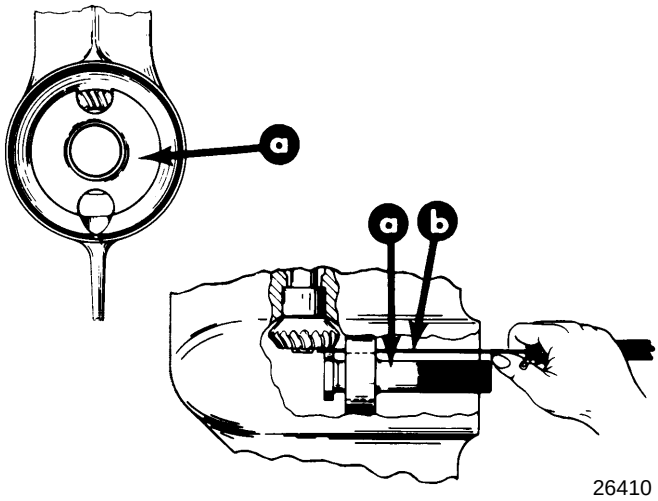
6. Measure pinion height as follows:

   a. Place pinion gear shimming tool in gear housing.

NOTE: *Take the following measurements at 3 locations, rotating drive shaft and pinion gear 120 degrees at a time.*

   b. Insert a .025 in. (0.64 mm) feeler gauge between one tooth of pinion gear and high point of shimming tool. Take 2 or more readings, rotating drive shaft and pinion gear 120 degrees at a time. Clearance should be .025 in. (0.64 mm) ± .001 in. (0.02 mm).

   c. If clearance is not correct, add or subtract shims from beneath drive shaft tapered roller bearing cup to obtain proper pinion gear height.



26410

a - Pinion Gear Shimming Tool (91-56048)
b - .025 in. (0.64 mm) Feeler Gauge

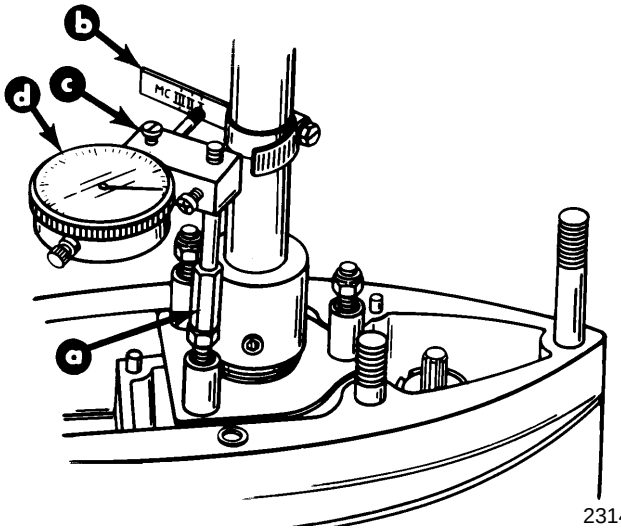
Checking Forward Gear Backlash

1. Install dial indicator as follows:

   a. Thread stud adaptor all the way onto stud. Make sure adaptor is snug.

   b. Install backlash indicator rod, dial indicator holding tool and dial indicator as shown.

   c. Position dial indicator pointer to line marked “I” on backlash indicator rod.

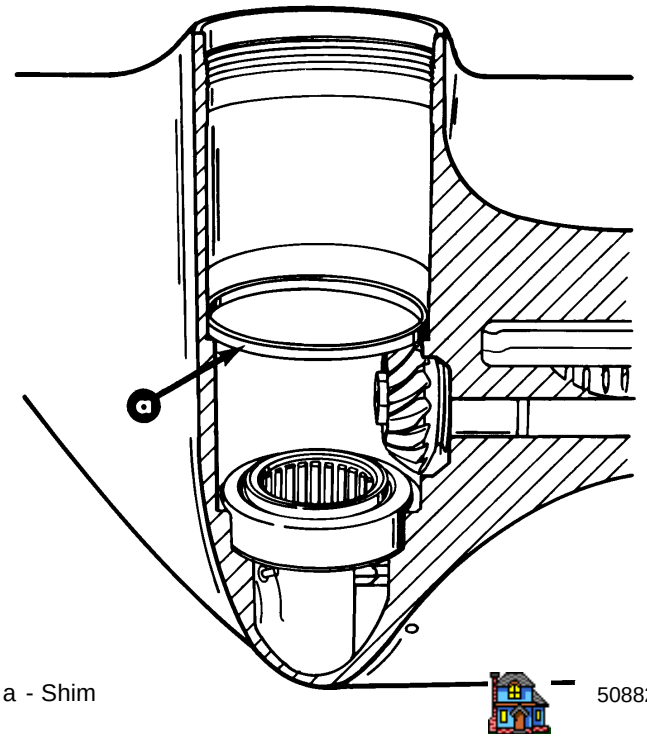


23146

a - Stud Adaptor (91-13948)
b - Backlash Indicator Rod (91-53459)
c - Dial Indicator Holding Tool (91-89897)
d - Dial Indicator (91-58222A1)

NOTE: *If forward gear shim was not retained, or if gear housing was replaced, start off by installing a .218 in. (5.53 mm) shim.*

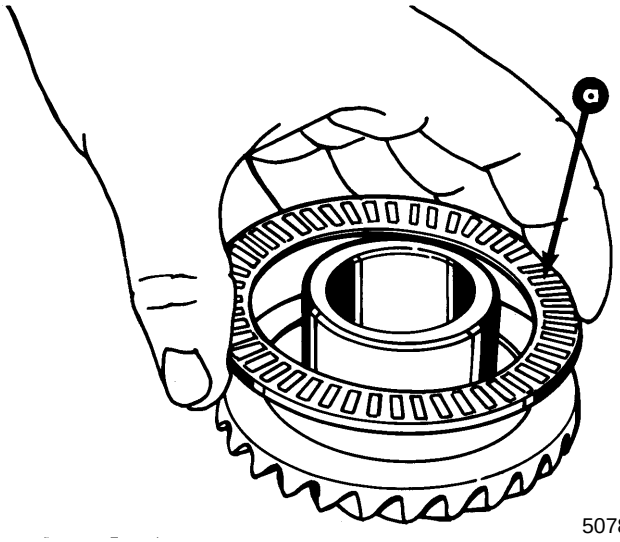
2. Install appropriate shim into gear housing. Ensure it is seated.



a - Shim

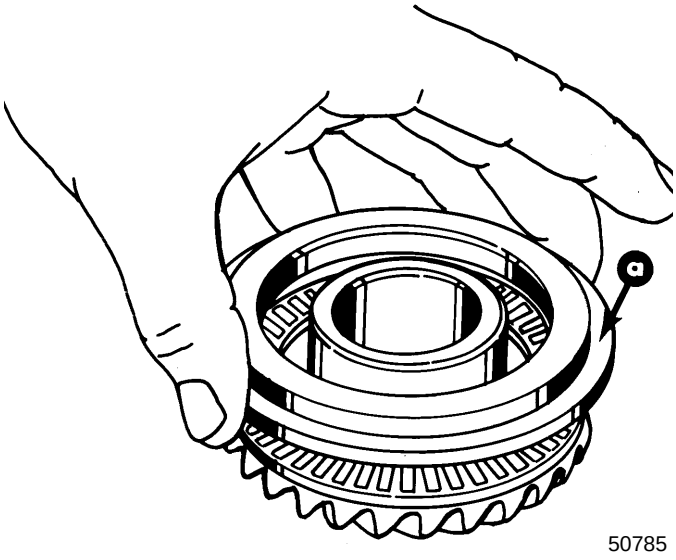
50882

3. Apply gear lube to thrust bearing and place on forward gear.



a - Thrust Bearing

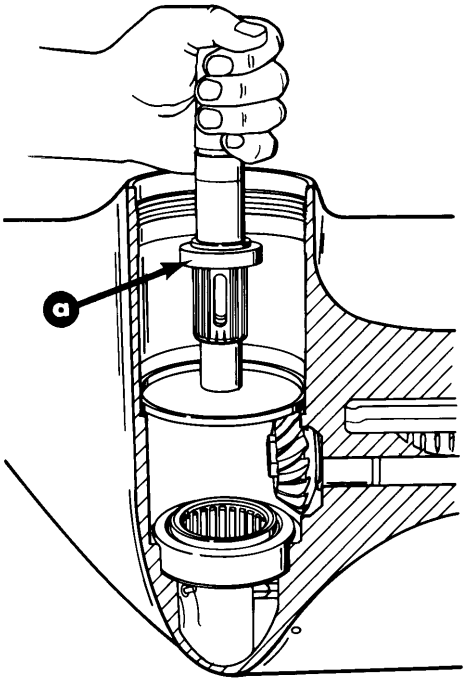
4. Install thrust race on top of thrust bearing with stepped side away from gear.



a - Thrust Race

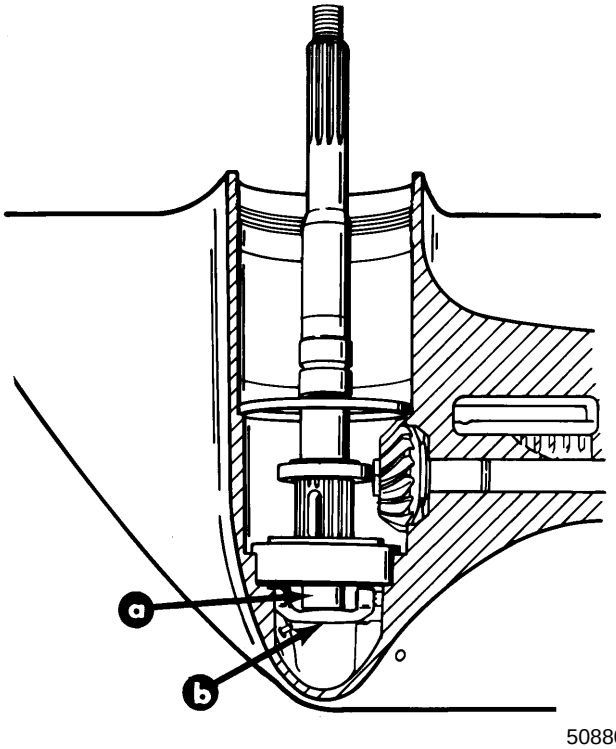
NOTE: *One of the propeller shaft thrust collars will be used as a special tool to place a load on the forward gear in the following procedure. Be careful to install as indicated or damage to collar could result.*

5. Install thrust collar on propeller shaft with stepped side facing the rear. Slide collar up against splines on sliding clutch area of propeller shaft.



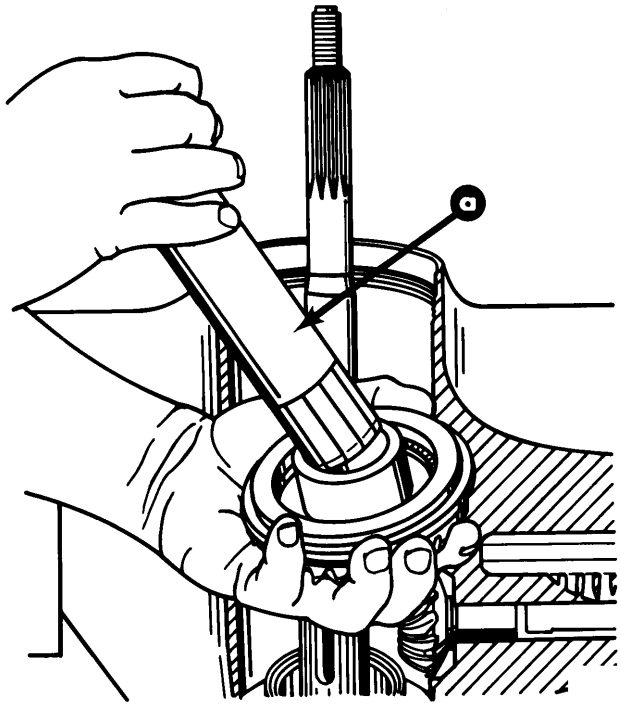
a - Thrust Collar

6. Install propeller shaft into gear housing and support bottom end on shift crank.



a - Propeller Shaft
b - Shift Crank

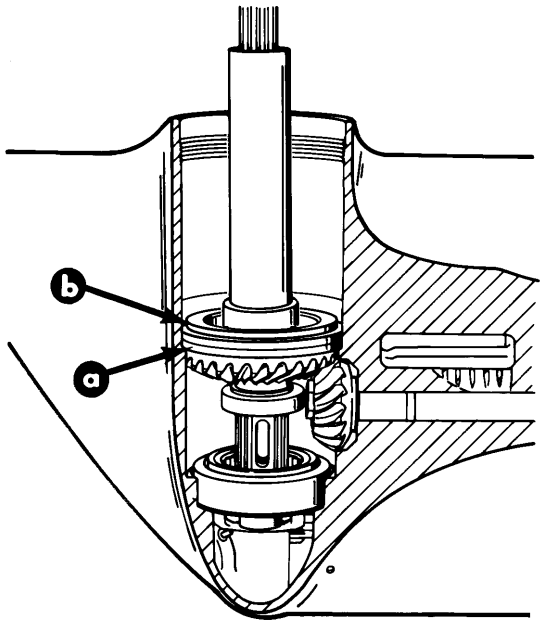
7. Place Installation Tool (91-815850) through forward gear as shown.



50880

a - Installation Tool

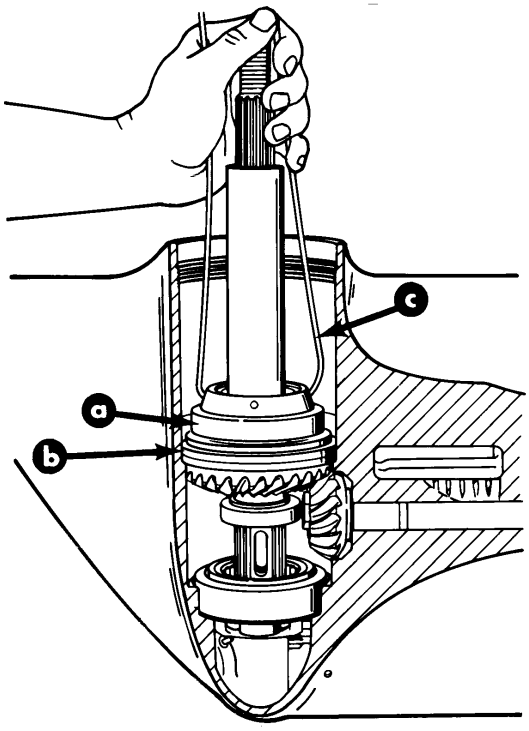
8. Lower forward gear with thrust bearing and race down over propeller shaft. Ensure thrust race is seated against shim by tapping it down with a soft punch. Do not nick surface.



50889

a - Shim
b - Thrust Race

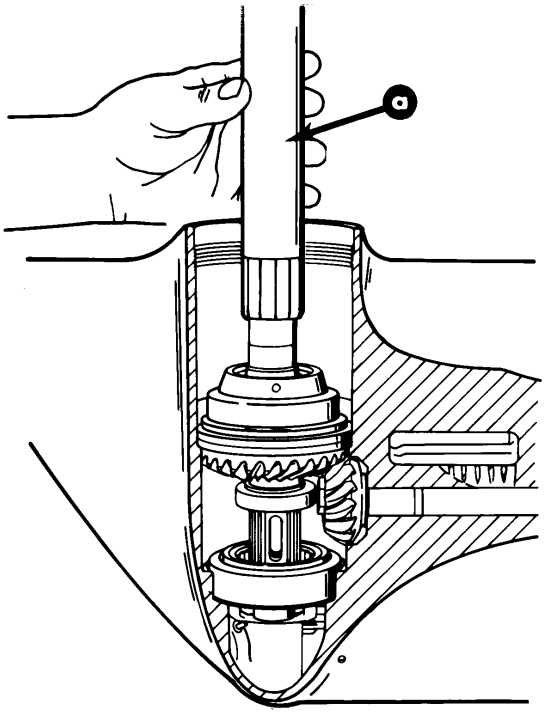
9. Install forward gear bearing adaptor down over forward gear using a hook tool. Ensure that bearing adaptor is completely seated on thrust race.



50889

a - Bearing Adaptor
b - Thrust Race
c - Hook Tool

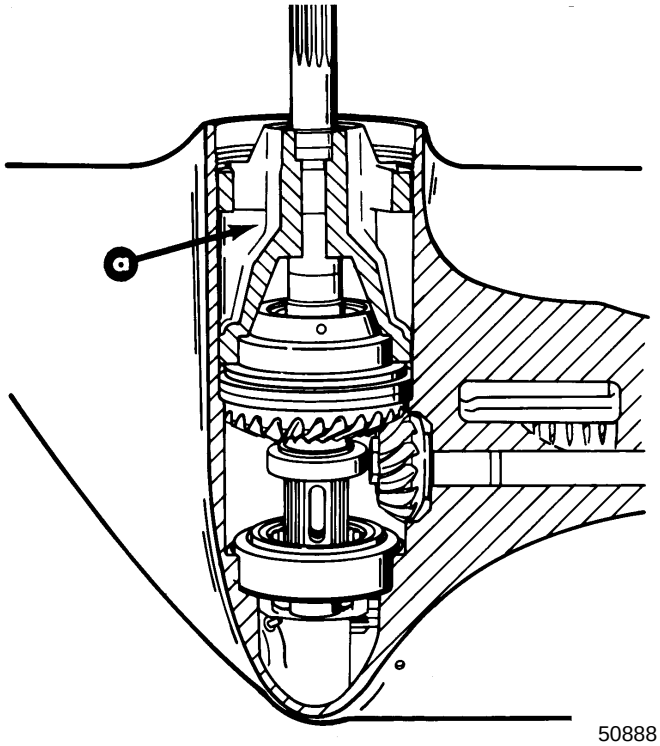
10. Remove forward gear installation tool while holding down on forward gear bearing adaptor.



50889

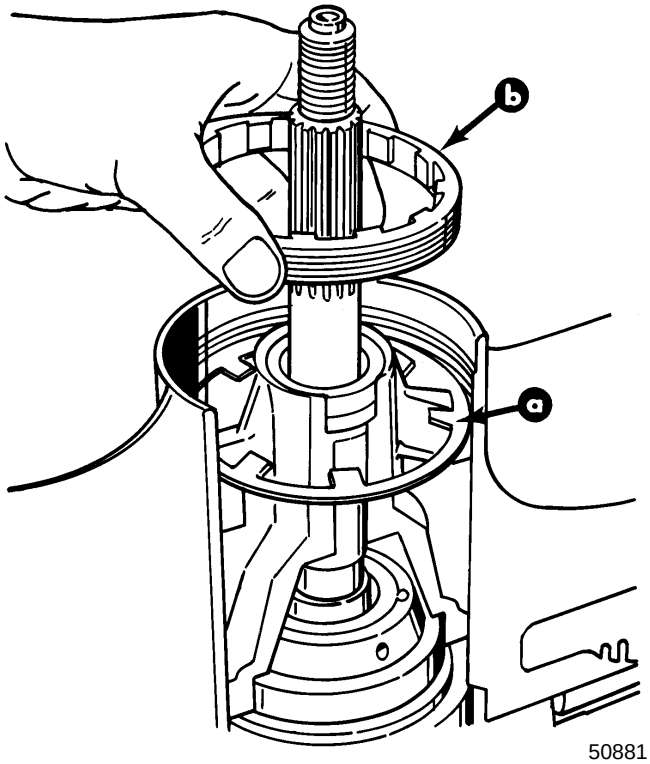
a - Installation Tool

11. Begin lowering bearing carrier down over propeller shaft. Once carrier is over end of shaft, hold up on propeller shaft until bearing carrier is fully seated.



a - Bearing Carrier

12. Install tab washer and bearing carrier retainer. Torque retainer to 210 lb. ft. (285 N·m).

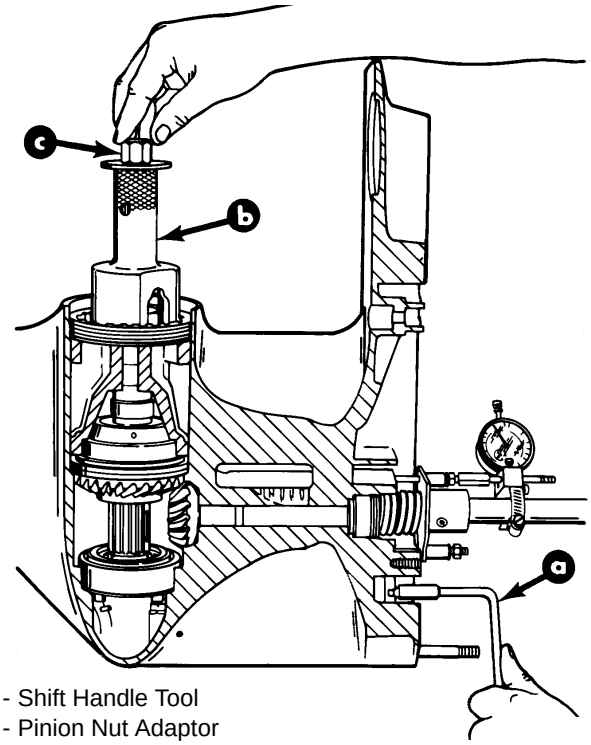


a - Tab Washer
b - Retainer

NOTE: *Refer to page 10 to modify Pinion Nut Adaptor if necessary. Newer style pinion adaptor does not need this modification.*

13. Install pinion nut adaptor over propeller shaft. Install a suitable size washer and a propeller nut.

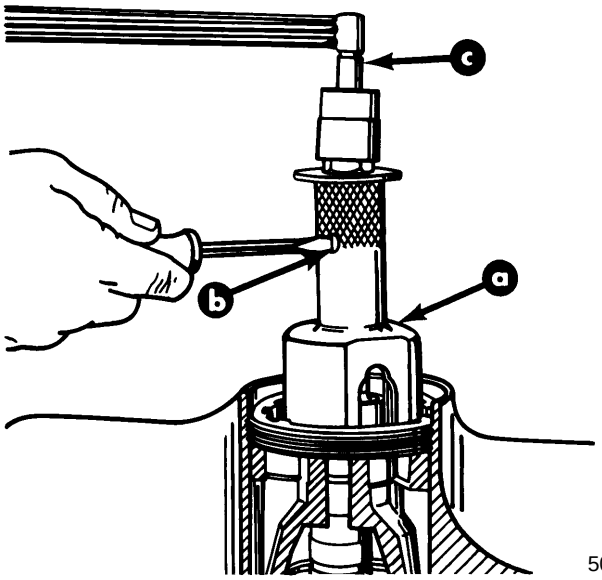
NOTE: *Use the shift handle tool to lift propeller shaft up so that enough thread will extend through pinion nut adaptor tool.*



a - Shift Handle Tool
b - Pinion Nut Adaptor
c - Washer and Propeller Nut

50883

14. Torque propeller nut to 45 lb. in. (5 N·m). Use a flat tip screwdriver, placed through hole in pinion nut adaptor tool, to engage propeller shaft splines and keep shaft from turning.

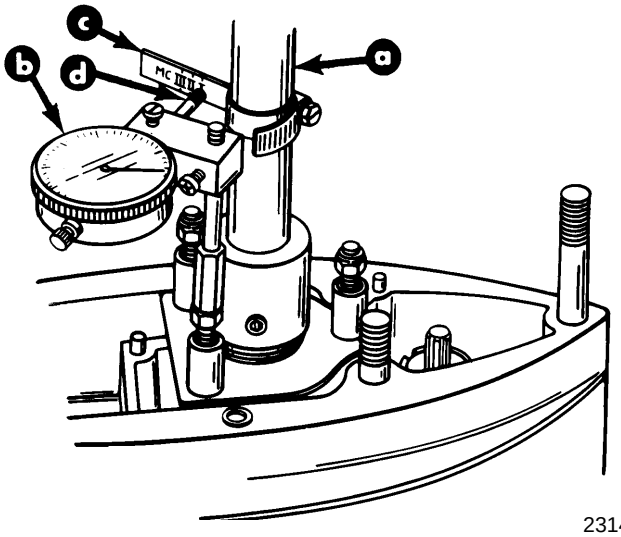


50880

a - Pinion Nut Adaptor
b - Hole
c - Torque Wrench

NOTE: *It will be necessary to re-establish the preload when moving the drive shaft in the following steps. This is necessary because the propeller nut may tighten or loosen when the drive shaft is turned to check backlash at 90 degree intervals, as explained following.*

15. Take backlash readings at 4 locations, rotating drive shaft 90 degrees at a time, as follows:
    a. Lightly turn drive shaft back and forth, so as to feel backlash between gears (no movement should be noticed at propeller shaft).
    b. Observe dial indicator. Reading must fall between .017-.028 in. (0.43-0.71 mm).
    c. To ensure reliability of results, take 3 or more backlash readings, turning drive shaft 90 degrees at a time. Be sure to loosen backlash indicator rod and realign dial indicator pointer with line marked “I” on indicator rod.



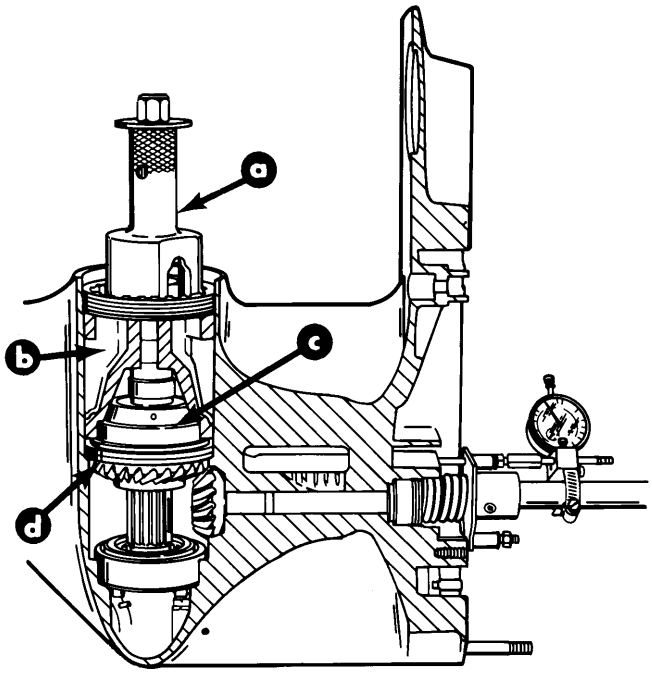
23146

a - Drive Shaft
b - Dial Indicator
c - Indicator Rod
d - Indicator Pointer

16. Perform step a, b, or c:
    a. **If Backlash is Less Than Required,** install a THICKER shim in front of the forward gear bearing adaptor assembly.
    b. **If Backlash is More Than Required,** install a THINNER shim in front of the forward gear bearing adaptor assembly.
    c. **If Backlash is Within Specifications,** Proceed to “CHECKING REVERSE GEAR BACKLASH.”

NOTE: *Changing shim thickness by .002 in. (0.050 mm) will change backlash by approximately .002 in. (0.050 mm).*

17. Once the forward gear shimming has been established, remove pinion nut adaptor, bearing carrier, forward gear bearing adaptor, shim and propeller shaft.



50888

a - Pinion Nut Adaptor
b - Bearing Carrier
c - Forward Gear Bearing Adaptor
d - Shim

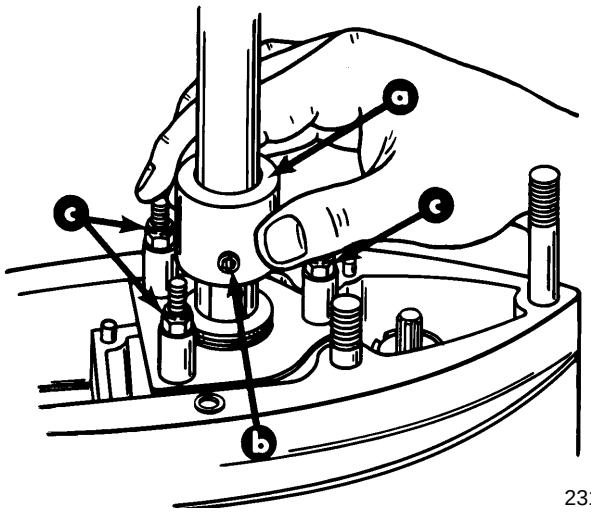
18. Remove thrust collar from propeller shaft.

19. Remove dial indicator and associated tools.

⚠CAUTION

Before loosening collar set screw, tighten preload tool nuts until they bottom on spacers.

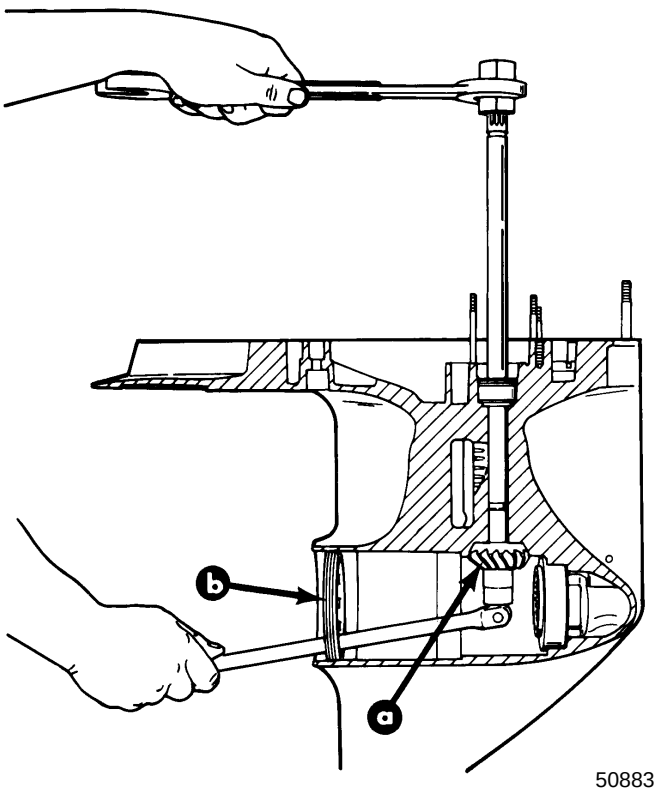
20. Remove bearing preload tool as follows:
    a. Tighten nuts until they bottom on threads.
    b. Loosen collar set screw and remove collar.
    c. Remove nuts and remaining preload tool components.



23145

a - Collar
b - Set Screw
c - Nuts (3)

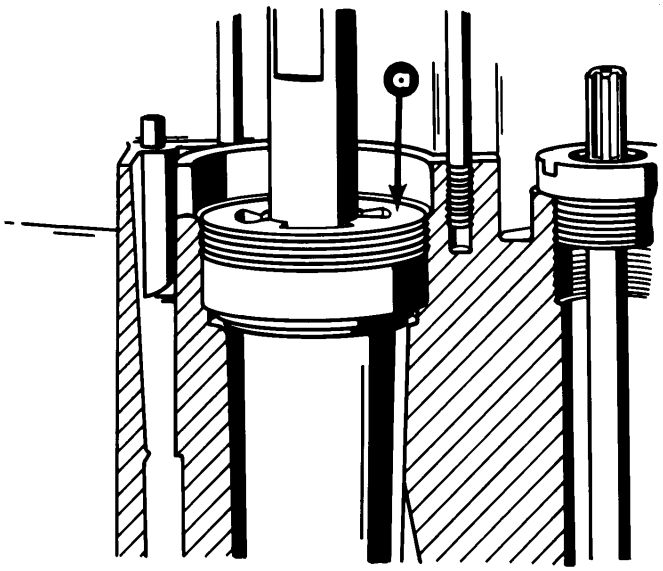
21. Remove pinion nut and remove pinion. Install bearing carrier retainer to protect gear housing threads.



50883

a - Pinion Gear And Nut
b - Bearing Carrier Retainer

22. Remove drive shaft retainer and lift out drive shaft. Insert cardboard sleeve into pinion bearing to keep rollers from falling out.

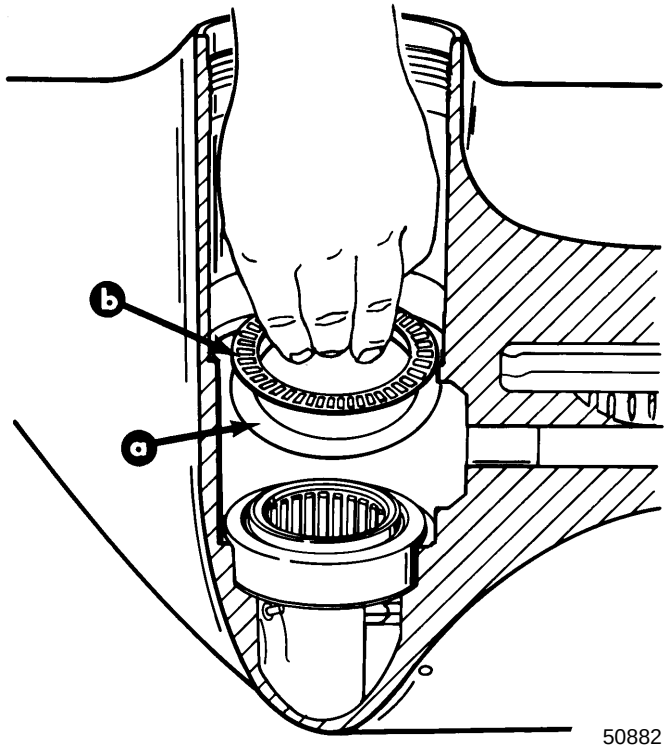


23352

a - Retainer

Checking Reverse Gear Backlash

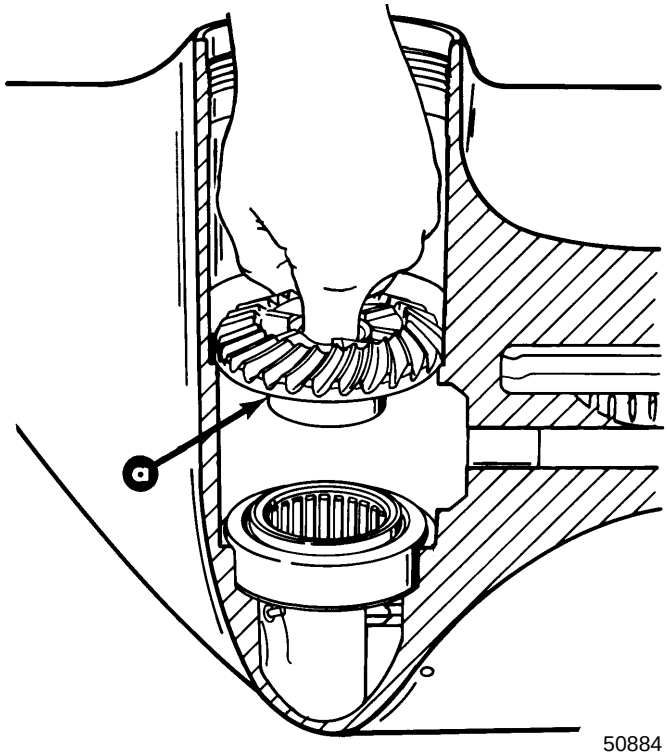
1. Ensure bearing adaptor race surface is clean. Coat thrust bearing with gear lube and install thrust race and bearing as shown.



50882

a - Thrust Race
b - Thrust Bearing

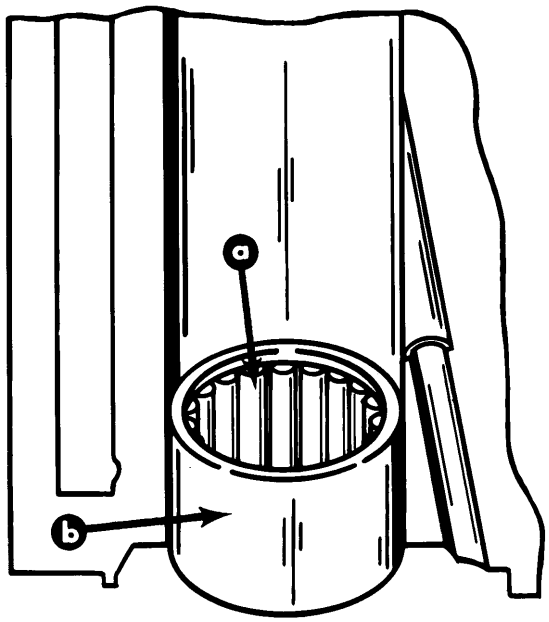
2. Install reverse gear into bearing adaptor.



50884

a - Reverse Gear

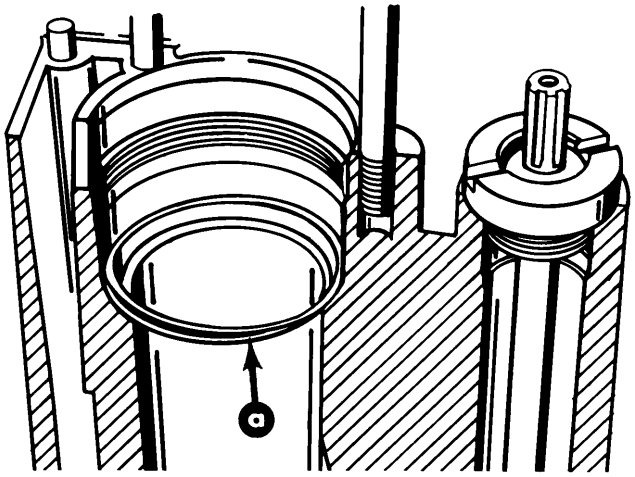
3. If pinion bearing was not replaced, but needle bearings have fallen out during disassembly, install 18 needles in needle bearing outer race. Use needle bearing assembly lubricant (91-825265A1) to help hold needles in place.



23142

a - Rollers (18)
b - Roller Bearing Outer Race

4. Place shim(s) in drive shaft housing bore.

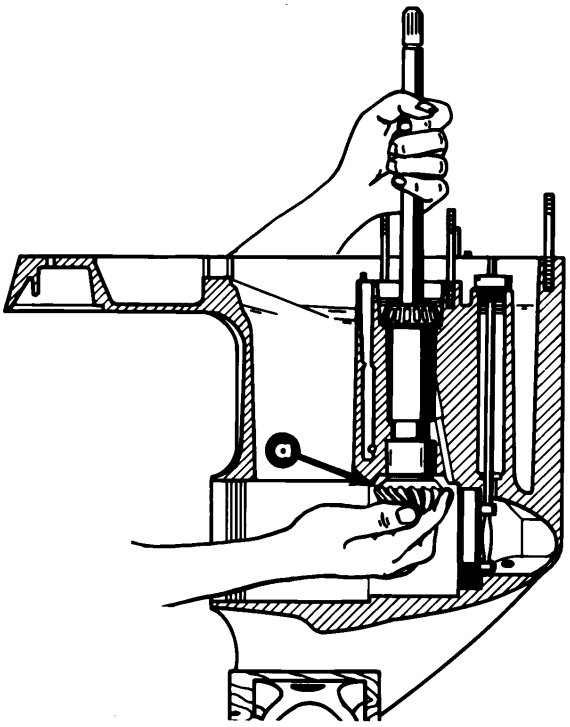


23351

a - Shim(s)

NOTE: *For ease of installation, glue washer to pinion gear, using 3M Adhesive (92-86166-1) or equivalent.*

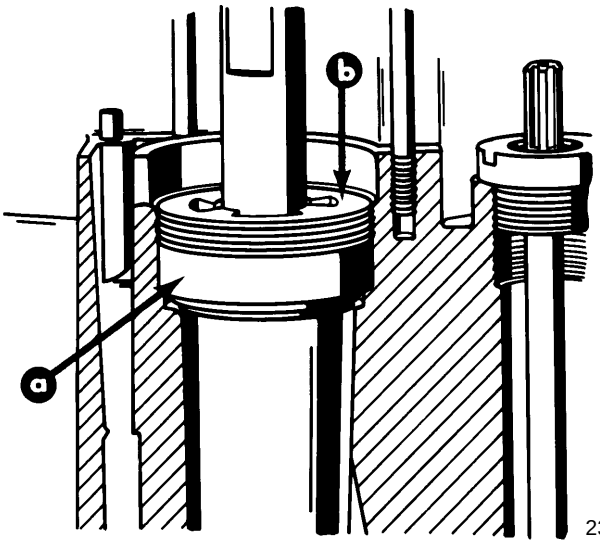
5. Place pinion gear and washer in gear housing.
6. Insert drive shaft into gear housing bore. Rotate drive shaft to engage drive shaft splines with pinion gear splines.
7. Hand thread nut onto drive shaft. DO NOT tighten further at this time. Install pinion nut with the machined shoulder against the pinion gear. If both sides of the nut have a machined shoulder, then either shoulder may be placed against the pinion gear.



23353

a - Pinion Gear, Nut And Washer

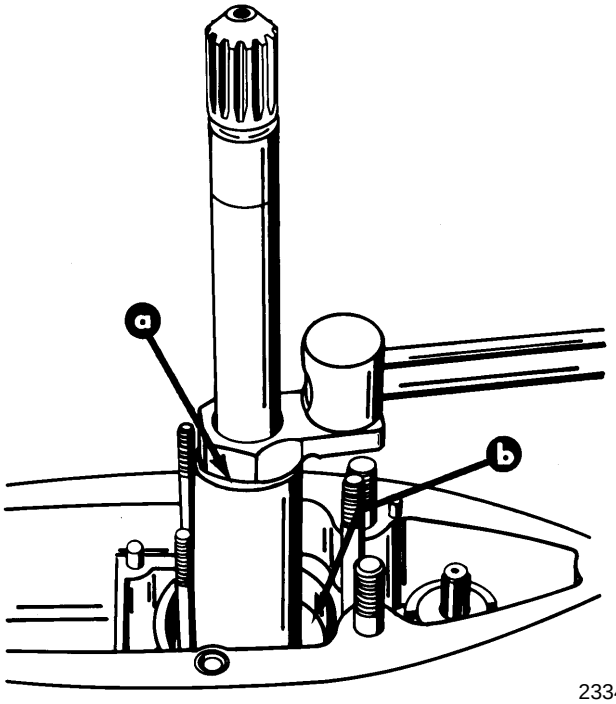
8. Apply Special Lubricant 101 to threads of retainer. Install bearing cup and retainer and tighten until snug.



23352

a - Bearing Cup
b - Retainer

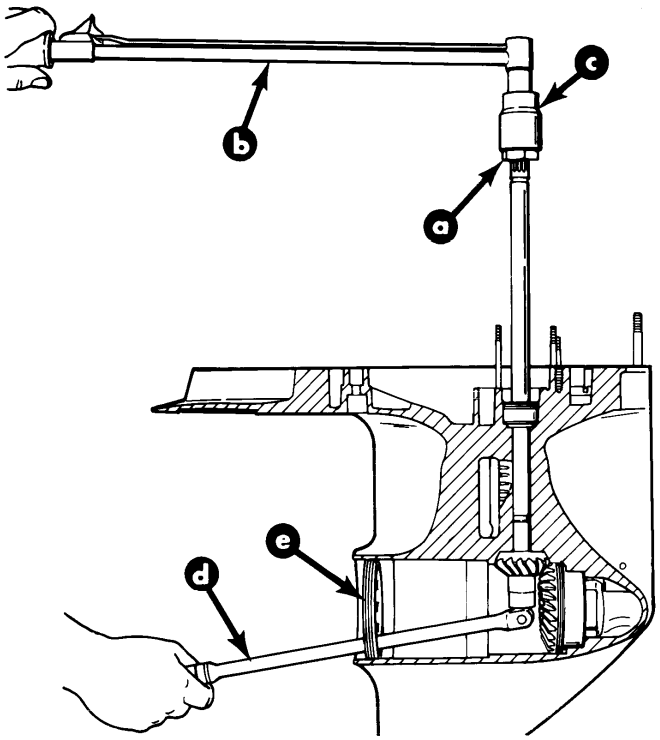
9. Torque retainer using Drive Shaft Bearing Retainer Tool (91-43506) to 100 lb. ft. (130 N·m).



23348

a - Drive Shaft Bearing Retainer Tool (91-43506)
b - Retainer

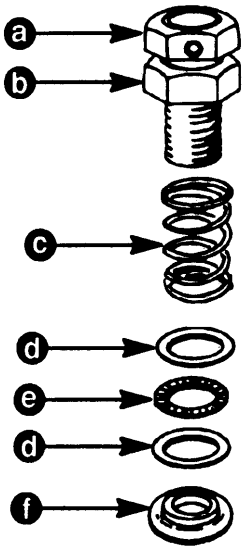
10. Partially install bearing carrier retainer nut (to protect threads) and torque pinion nut to 60-80 lb. ft. (81-108 N·m).



50890

a - Drive Shaft Nut Wrench (91-56775)
b - Torque Wrench
c - Socket
d - Breaker Bar
e - Bearing Carrier Retainer

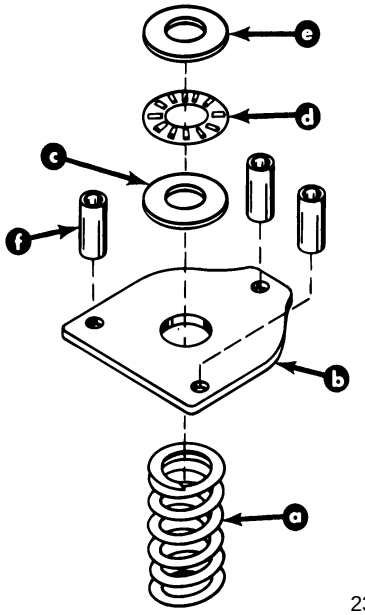
11. Install the following components from Bearing Preload Tool (91-14311A2) over drive shaft in order shown.



75750

Current Style Preload Tool Installation

a - Top Nut With Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer

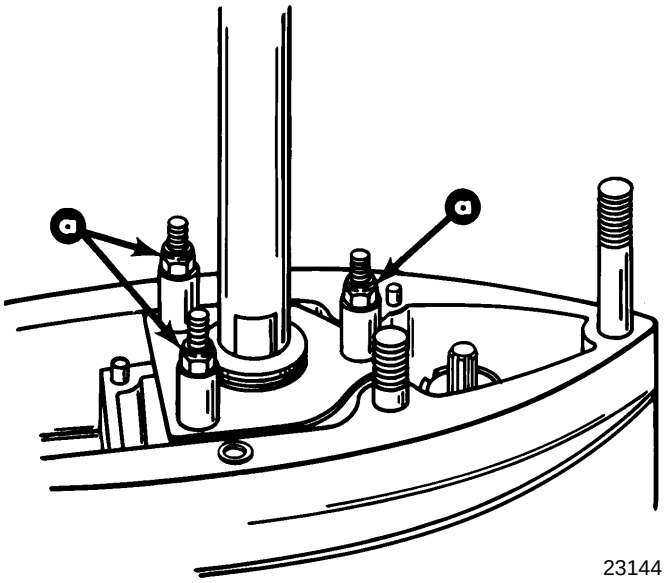


23144

Early Style Preload Tool Installation

a - Spring
b - Plate
c - Washer
d - Bearing
e - Washer
f - Spacers (3)

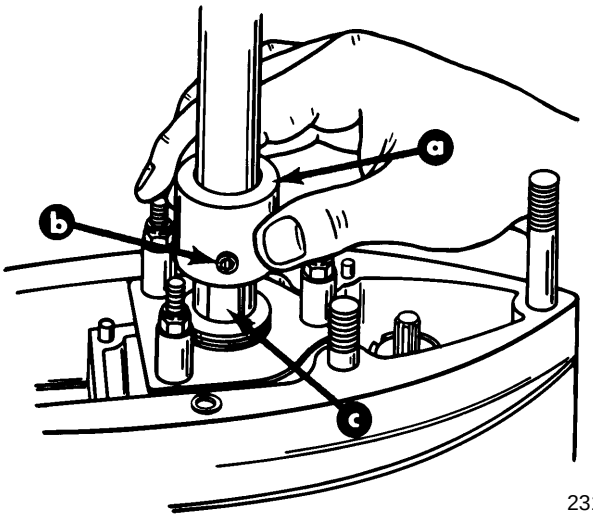
12. Install and tighten nuts until they just bottom on spacers.



23144

a - Nuts (3)

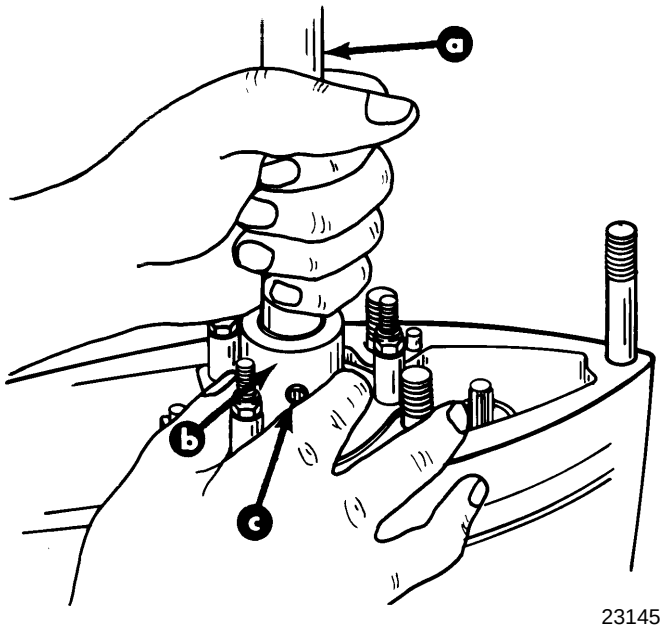
13. Place collar (from Bearing Preload Tool 91-14311A2) over drive shaft with set screw down. Align set screw with flat on drive shaft.



23145

a - Collar
b - Set Screw
c - Flat on Drive Shaft

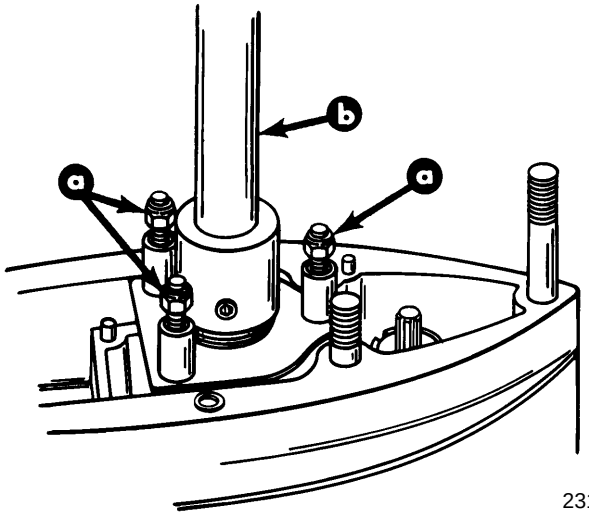
14. Pull up on drive shaft, push down on collar and tighten set screw.



23145

a - Drive Shaft
b - Collar
c - Set Screw

15. Loosen nuts 3-4 turns and turn drive shaft clockwise 2 or more turns to seat bearings.



23146

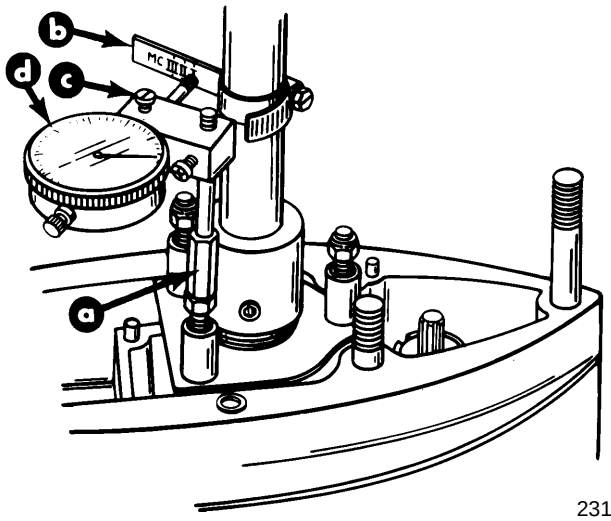
a - Nuts (3)
b - Drive Shaft

16. Install dial indicator as follows:

    a. Thread stud adaptor all the way onto stud. Make sure adaptor is snug.

b. Install Backlash Indicator Rod, Dial Indicator Holding Tool and Dial Indicator as shown.

c. Position dial indicator pointer to line marked “I” on Backlash Indicator Rod.



23146

a - Stud Adaptor (91-13948)
b - Backlash Indicator Rod (91-53459)
c - Dial Indicator Holding Tool (91-89897)
d - Dial Indicator (91-58222A1)

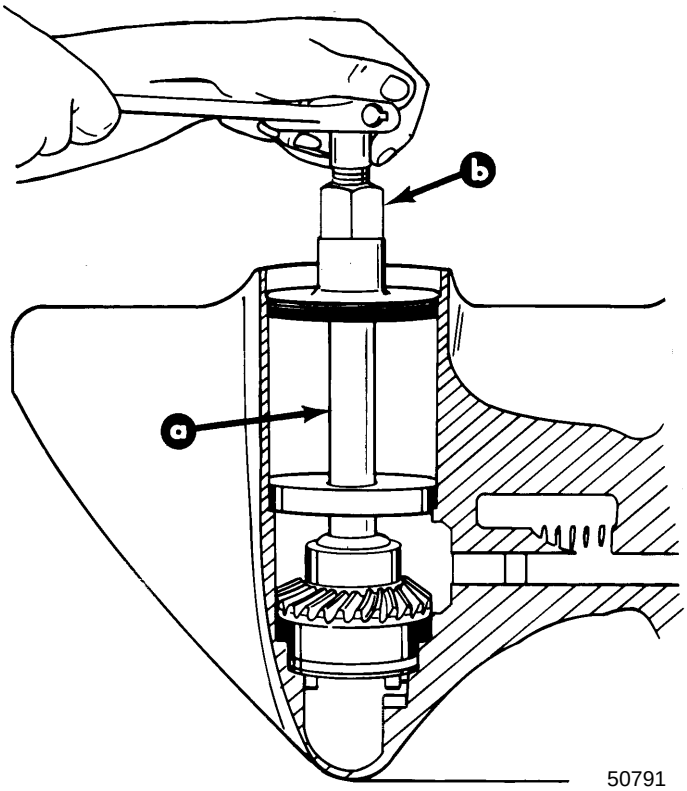
NOTE: *Reverse Gear Bearing Adaptor Installation Tool (91-18605A2) is used to apply a light preload of reverse gear in the following steps.*

17. Apply a light preload to reverse gear using Bearing Adaptor Installation Tool (91-18605A2) to hold gear against thrust bearing as follows:

    a. Install tool in gear housing and tighten until one or two threads are showing in gear housing bore.

    b. Turn driver bolt in by hand until a slight resistance is felt (driver head contacts reverse gear).

    c. Torque driver bolt to 45 lb. in. (5 N·m).



50791

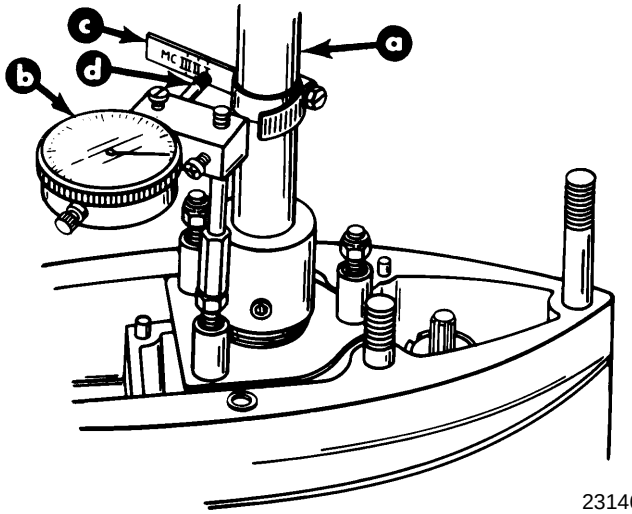
a - Bearing Adaptor Installation Tool
b - Driver Bolt

18. Take backlash readings at 4 locations, rotating drive shaft 90 degrees at a time, as follows:

    a. Lightly turn drive shaft back and forth, so as to feel backlash between gears (no movement should be noticed at propeller shaft).

    b. Observe dial indicator. Reading must fall between .020-.030 in. (0.50-0.76 mm).

c. To ensure reliability of results, take 3 more backlash readings, turning drive shaft 90 degrees at a time. Be sure to loosen backlash indicator rod and realign dial indicator pointer with mark on rod.



23146

a - Drive Shaft
b - Dial Indicator
c - Indicator Rod
d - Indicator Pointer

19. Perform step a, b, or c:

a. **If Backlash is Less Than Required,** REMOVE appropriate shim thickness from behind reverse gear bearing adaptor.

b. **If Backlash is More Than Required,** ADD appropriate shim thickness behind reverse gear bearing adaptor.

c. **If Backlash is Within Specifications,** proceed with reassembly of gear housing.

NOTE: *By adding or subtracting .001 in. (0.025 mm) shim, the backlash will change approximately .001 in. (0.025 mm).*

20. Remove bearing adaptor installation tool.

21. Remove dial indicator and associated tools.

⚠CAUTION

Before loosening collar set screw, tighten bearing preload tool nuts until they bottom on spacers.

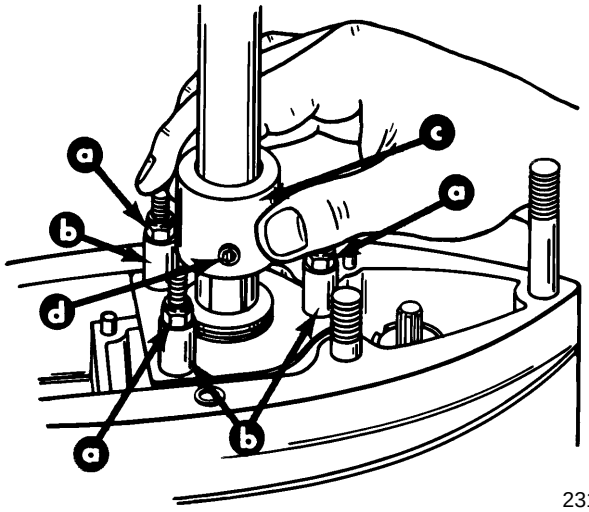
22. Remove bearing preload tool as follows:

a. Tighten 3 nuts until they bottom on spacers.

b. Loosen collar set screw and remove collar.

c. Remove remaining bearing preload tool components.

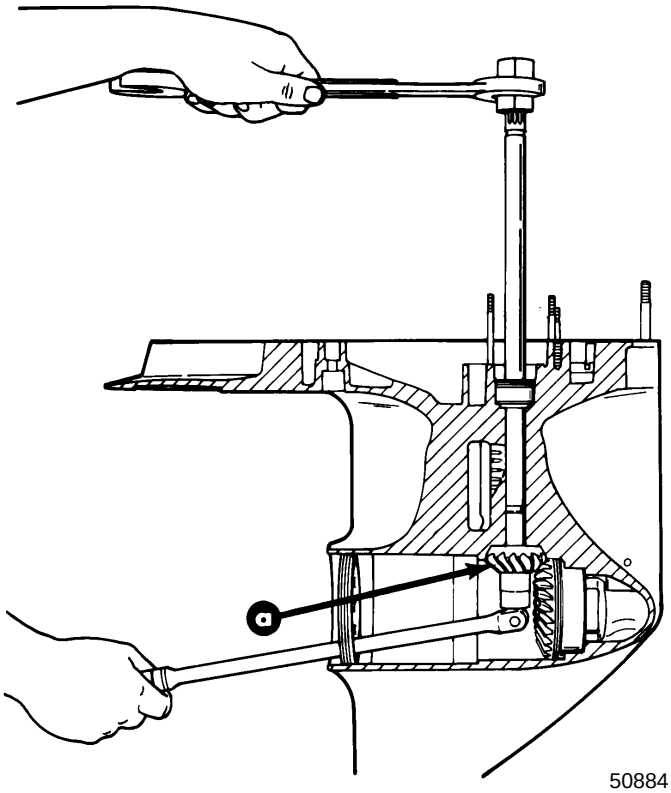
d. Remove drive shaft bearing retainer nut.



23145

a - Nuts (3)
b - Spacers
c - Collar
d - Set Screw

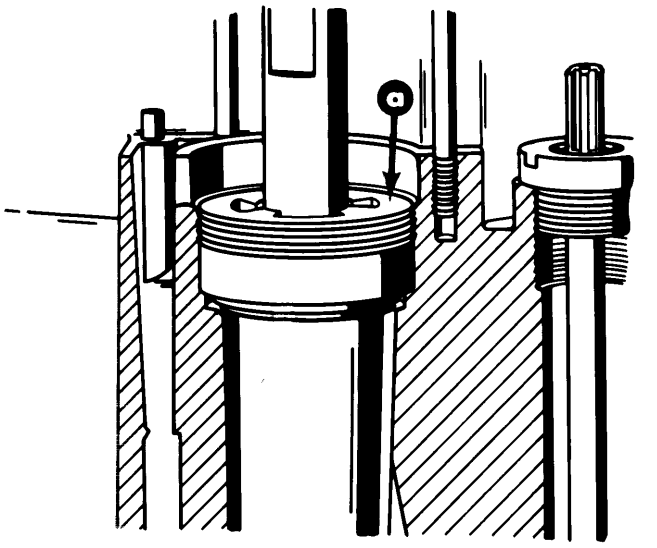
23. Remove pinion nut and pinion gear. Install bearing carrier retainer to protect gear housing threads.



50884

a - Pinion Gear and Nut

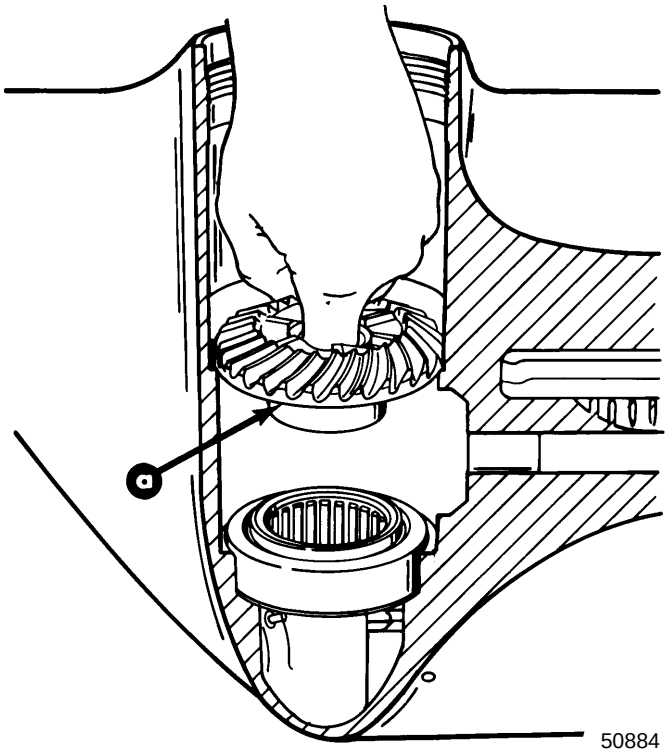
24. Remove drive shaft retainer and lift out drive shaft.



23352

a - Retainer

25. Remove reverse gear. Thrust bearing and thrust race should be left in gear housing.

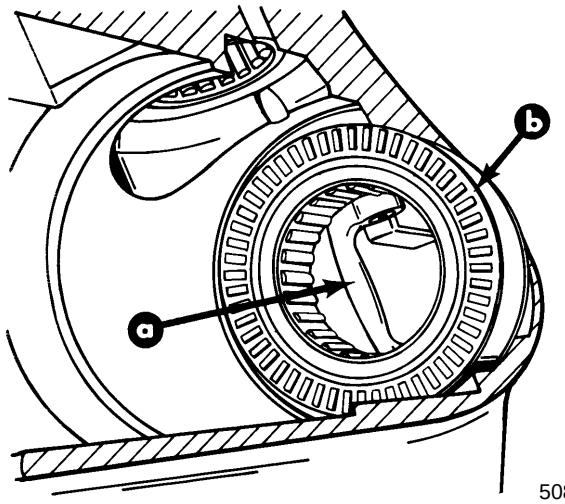


50884

a - Reverse Gear

Gear Housing Reassembly

1. Position shift crank toward the back of gear housing until it stops against bearing adaptor. Position shift handle tool so that weight of tool will hold shift crank in this position.

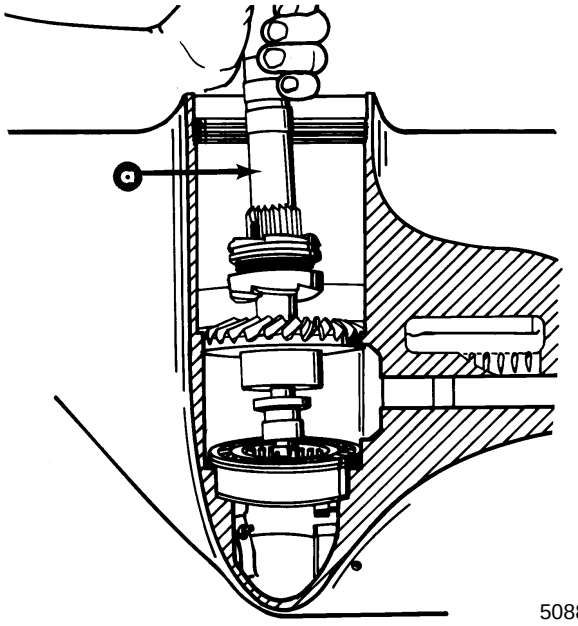


50885

a - Shift Crank
b - Bearing Adaptor

2. Tilt aft end of propeller shaft assembly toward left (port) side of gear housing and begin to lower it into gear housing.

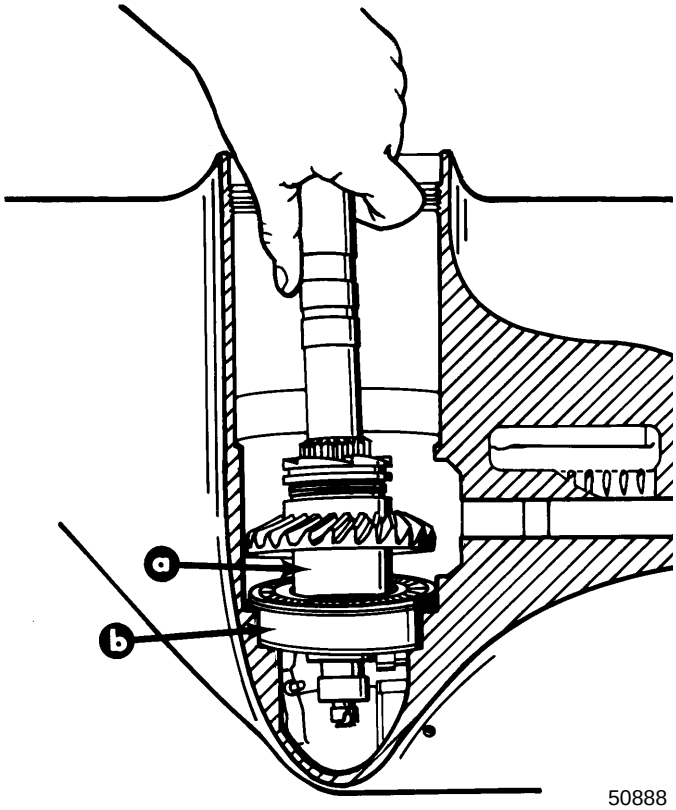
IMPORTANT: The roller bearings in the reverse gear can be dislodged. Be careful when inserting the propeller shaft into reverse gear to avoid dislodging a roller. If a roller does become dislodged, it can be snapped back into place. Inspect the propeller shaft and roller bearing to ensure they were not damaged in the process.



50888

a - Propeller Shaft

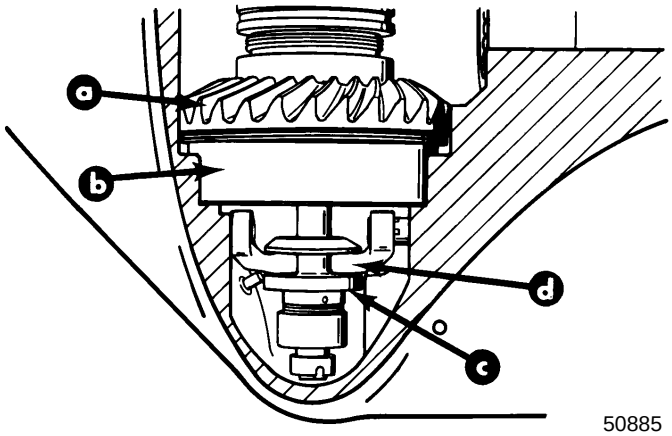
3. With propeller shaft tilted to the left (port) side of gear housing, continue to lower propeller shaft assembly until reverse gear hub comes in contact with the reverse gear bearing adaptor and the propeller shaft is fully inserted into the reverse gear.



50888

a - Reverse Gear Hub
b - Bearing Adaptor

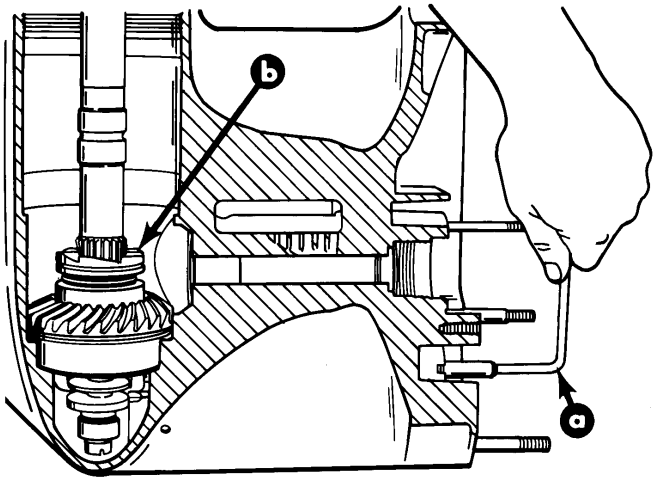
4. Slowly move propeller shaft to center of housing and lower reverse gear into bearing adaptor. Shift spool should engage with shift crank as the propeller shaft centers itself.



50885

a - Reverse Gear
b - Bearing Adaptor
c - Shift Spool
d - Shift Crank

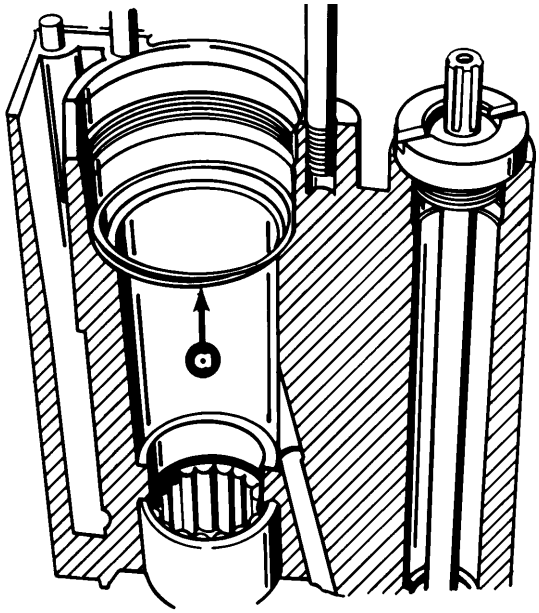
5. Ensure shift spool is properly engaged with shift crank by operating shift shaft with shift handle tool. Shift crank must push and pull sliding clutch and must fully engage reverse gear.



50886

a - Shift Handle Tool
b - Sliding Clutch

6. Install drive shaft as follows:
   a. Install original shims or shim thickness determined from checking pinion gear height, into drive shaft bore.



23351

a - Shims

b. Apply Loctite 27131 or Type “A” to pinion nut threads.

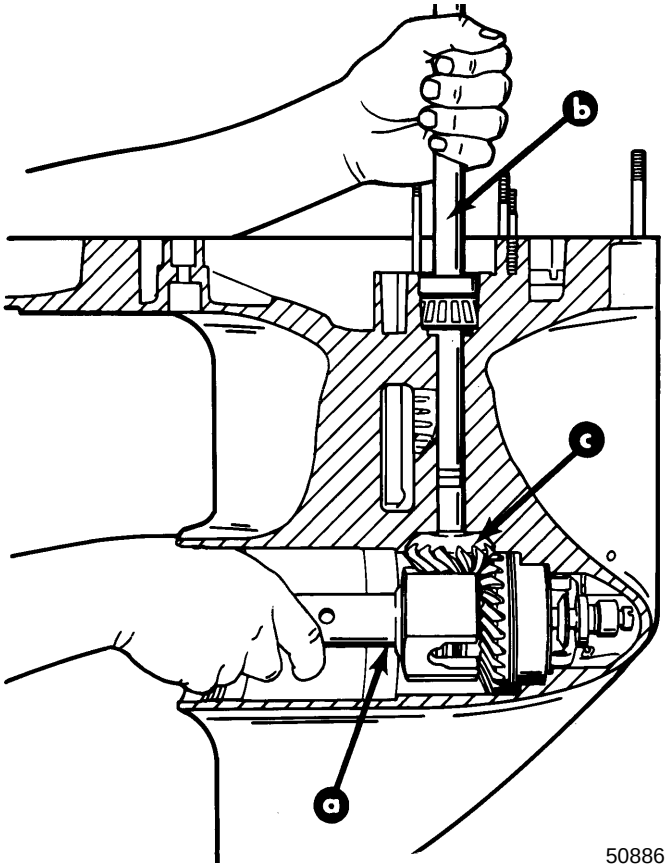
c. Place pinion nut on pinion nut adaptor.

NOTE: *To aid in installation, glue the pinion nut washer to the pinion gear.*

d. Install drive shaft and pinion gear. Rotate drive shaft to allow drive shaft splines and pinion gear splines to engage. DO NOT push pinion gear completely onto drive shaft until pinion nut adaptor (with nut and washer is in place in the following step).

e. Insert pinion nut adaptor (with nut and washer) into gear housing. Start pinion nut threads on drive shaft by rotating drive shaft.

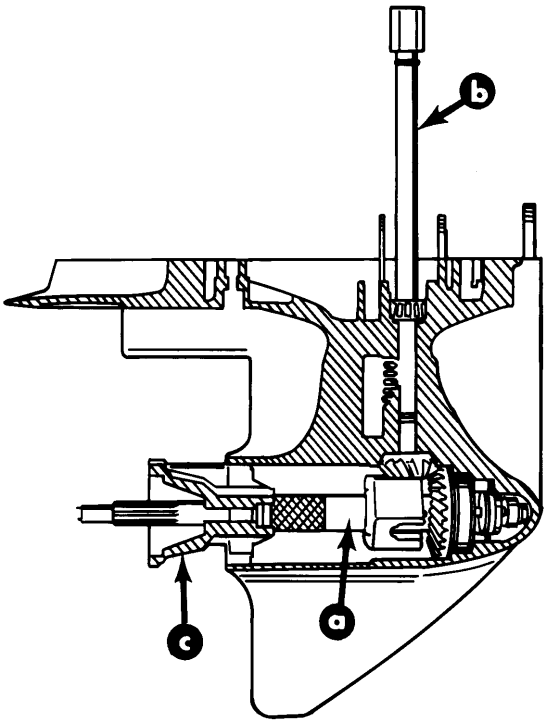
Install pinion nut with the machined shoulder against the pinion gear. If both sides of the nut have a machined shoulder, then either shoulder may be placed against the pinion gear.



50886

a - Pinion Nut Adaptor
b - Drive Shaft
c - Pinion Gear

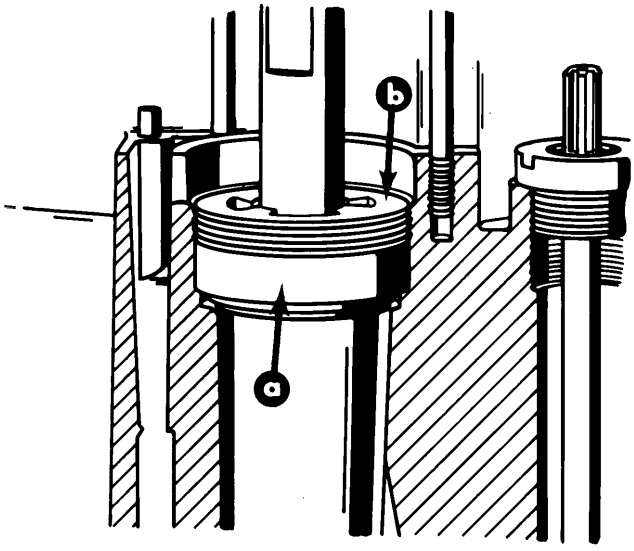
f. Install bearing carrier into gear housing backwards to hold propeller shaft and pinion nut adaptor straight when tightening nut.



50787

a - Pinion Nut Adaptor (91-61067A3)
b - Drive Shaft
c - Bearing Carrier

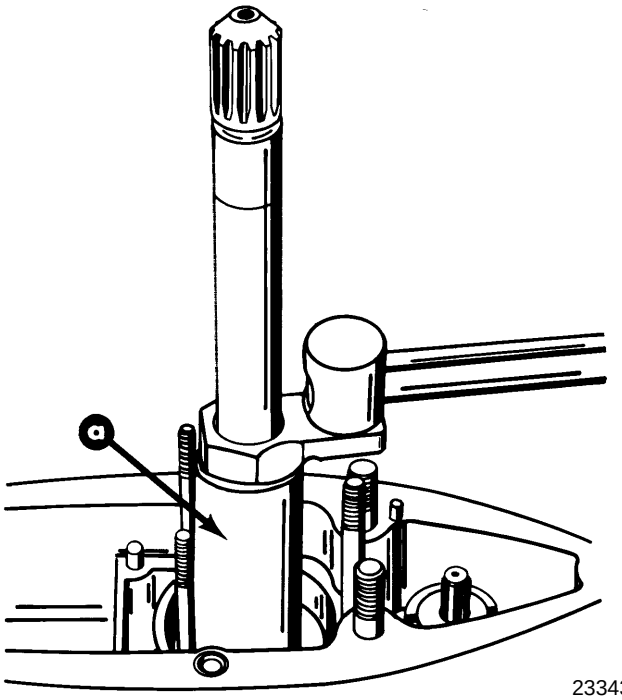
g. Install drive shaft tapered roller bearing cup and retainer.



23352

a - Bearing Cup
b - Retainer

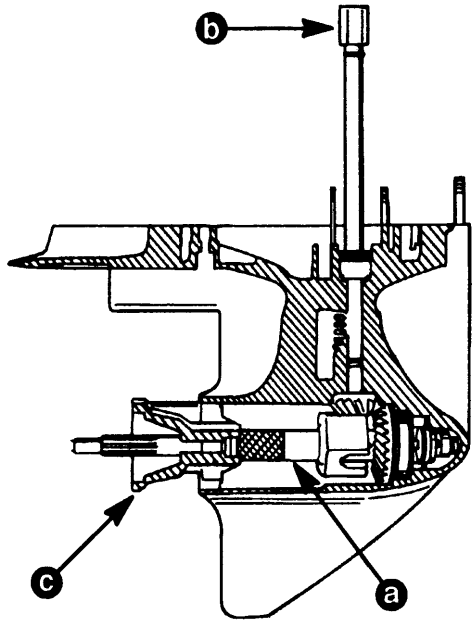
h. Torque retainer to 100 lb. ft. (130 N·m).



23343

a - Drive Shaft Bearing Retainer Tool (P/N 91-43506)

i. Torque pinion nut by turning drive shaft using pinion nut wrench and torque wrench with appropriate socket, to 60-80 lb. ft. (81-108 N·m).

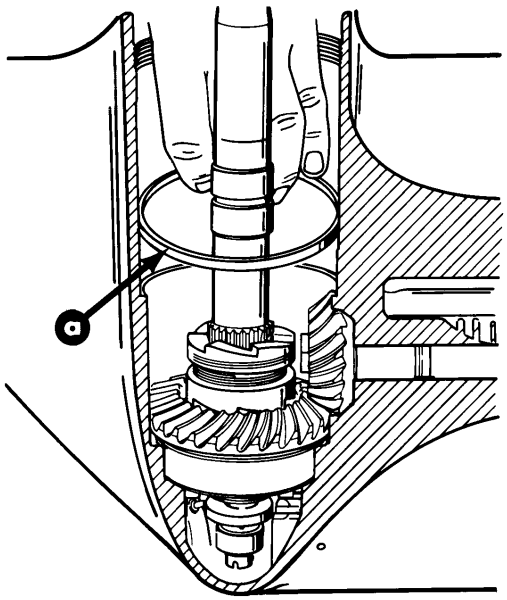


73873

a - Pinion Nut Adaptor
b - Drive Shaft Adaptor
c - Bearing Carrier

j. Remove bearing carrier, pinion nut adaptor and drive shaft nut wrench.

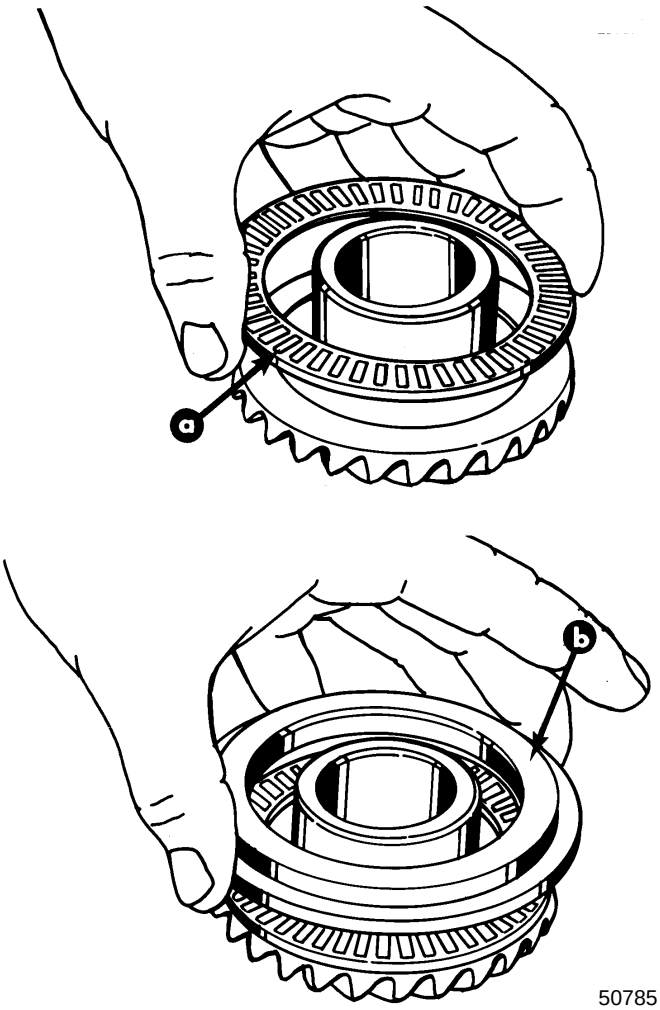
7. Install appropriate shim in gear housing.



50782

a - Shim

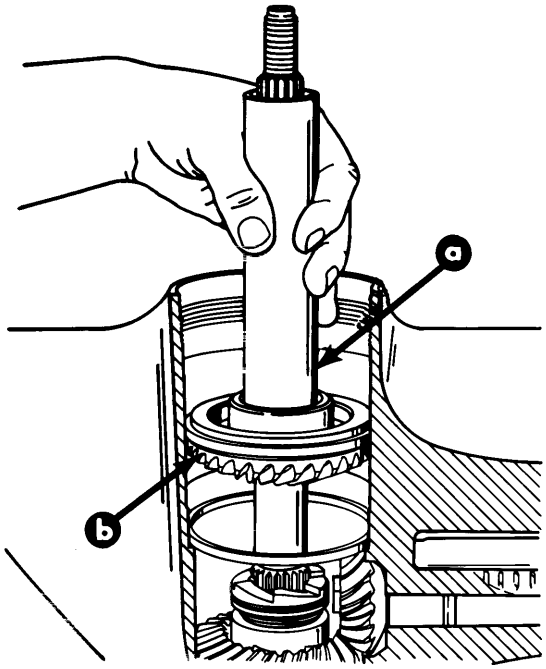
8. Apply gear lube to thrust bearing and place on forward gear. Place thrust race on top of thrust bearing with **stepped side up** as shown.



50785

a - Thrust Bearing
b - Thrust Race

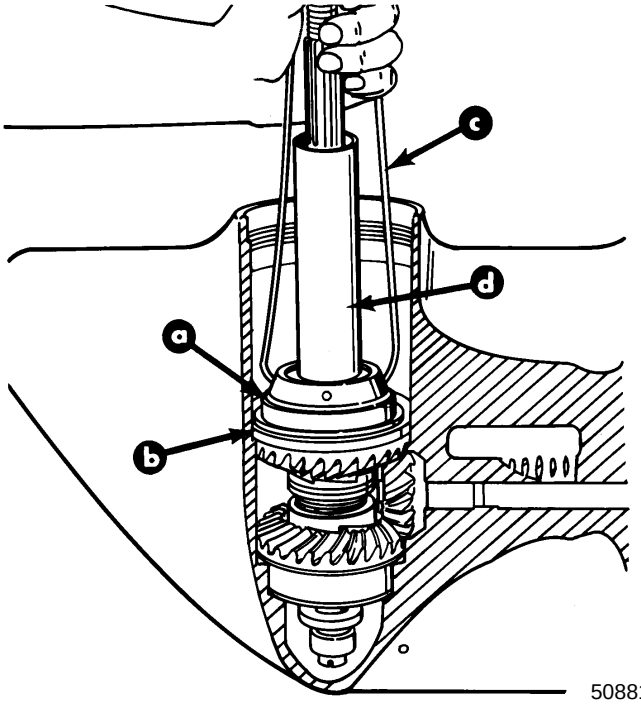
9. Use Forward Gear Installation Tool (91-815850) to install forward gear down over propeller shaft. Ensure thrust race seats evenly on shim. Tap down lightly using a soft punch.



50783

a - Forward Gear Installation Tool
b - Forward Gear

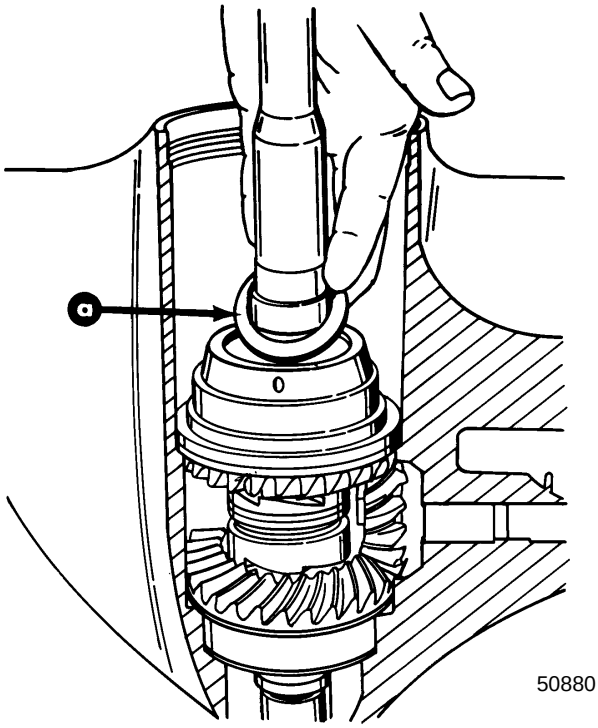
10. Install forward gear bearing adaptor using a hook tool as shown (Refer to end of this section to fabricate this tool). Ensure adaptor seats evenly against thrust race. Remove hook tool and forward gear installation tool.



50881

a - Forward Gear Bearing Adaptor
b - Thrust Race
c - Hook Tool
d - Forward Gear Installation Tool

11. Install small thrust race on top of bearing adaptor. Ensure top of bearing adaptor is clean.

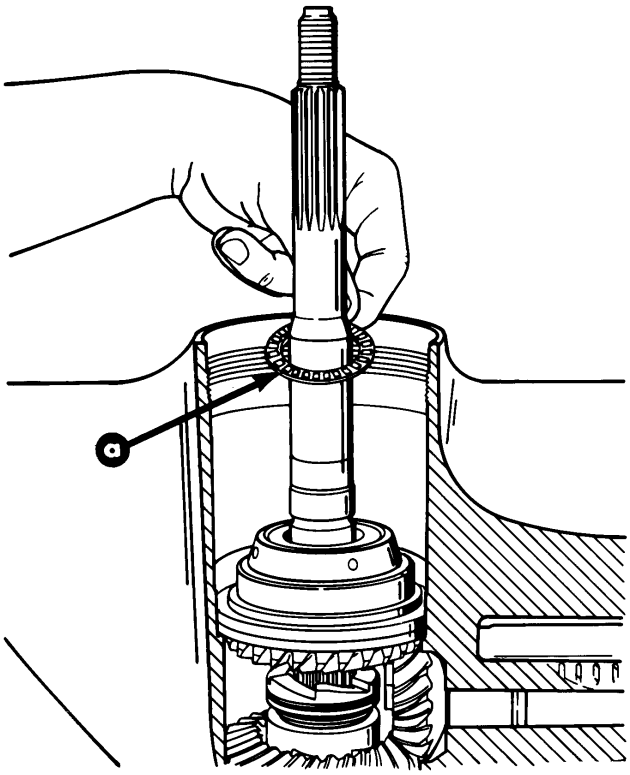


50880

a - Thrust Race

12. Apply gear lube to thrust bearing and install on top of thrust race.

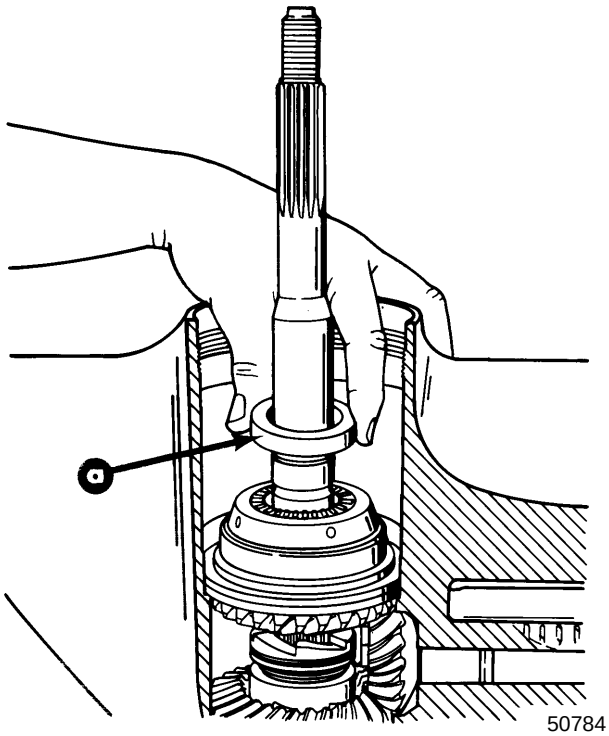
(Orientation does not matter, as bearing is the same on both sides.)



50783

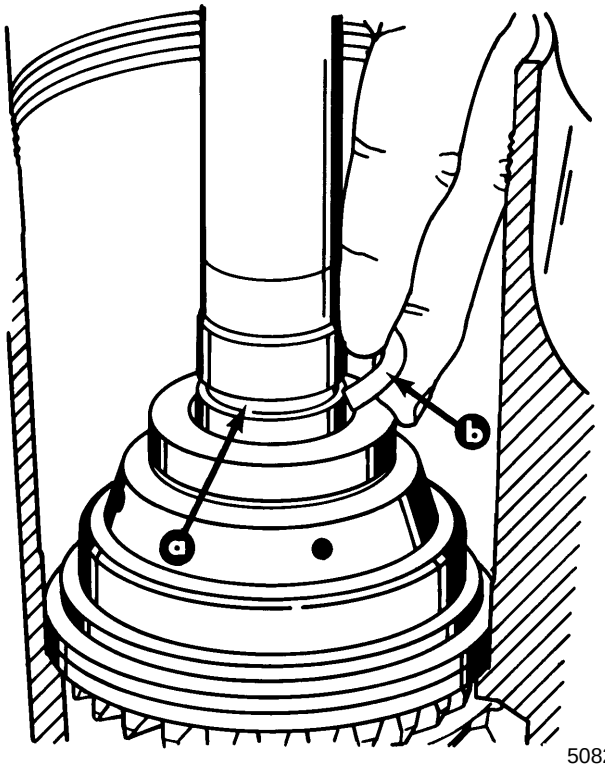
a - Thrust Bearing

13. Install thrust collar with stepped side down. Seat collar in bearing.

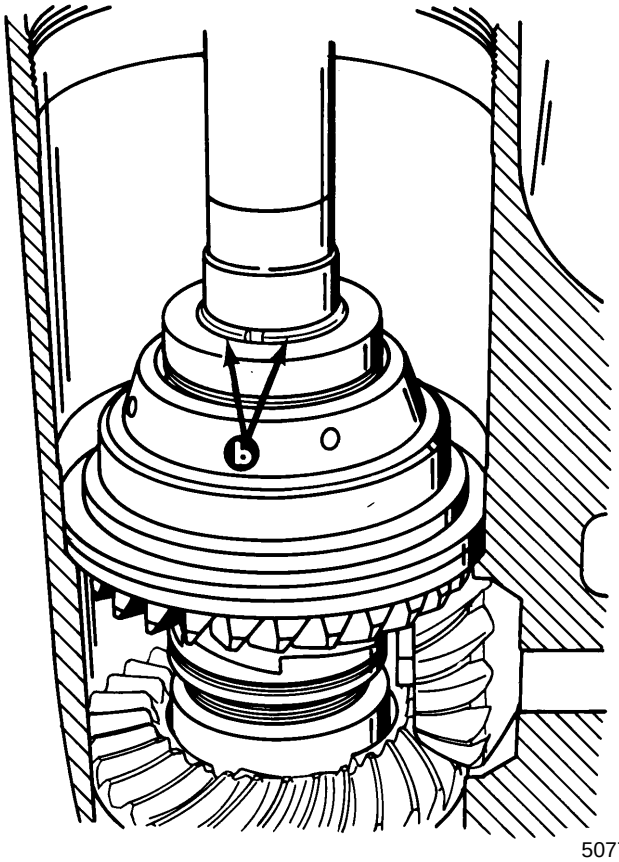


a - Thrust Collar

14. Pull up lightly on propeller shaft to expose groove for keepers. Install two keepers in groove and lower propeller shaft to hold them in place.

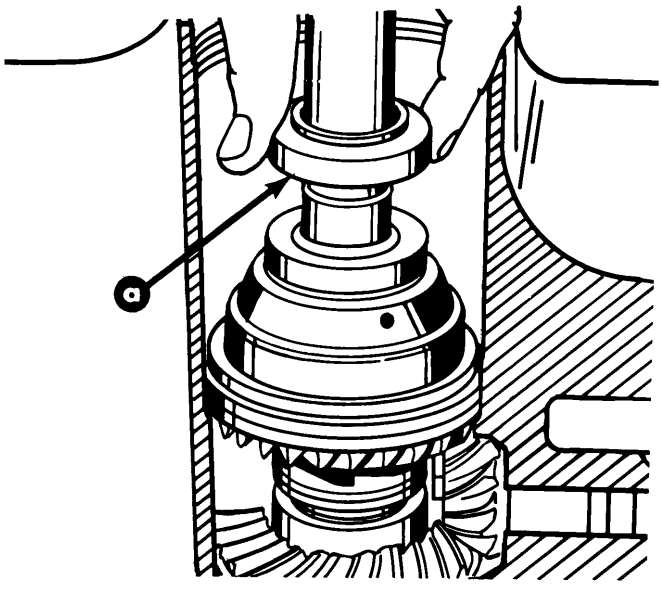


a - Groove
b - Keepers



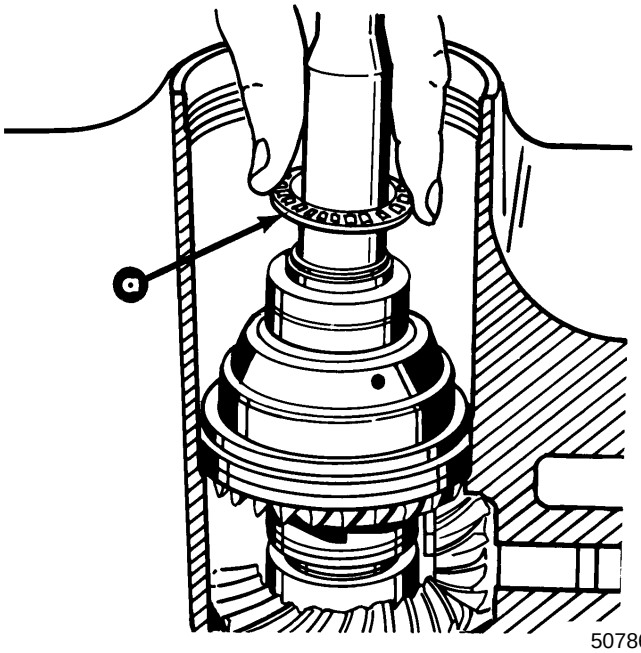
b - Keepers

15. Install second thrust collar with stepped side up.



a - Thrust Collar

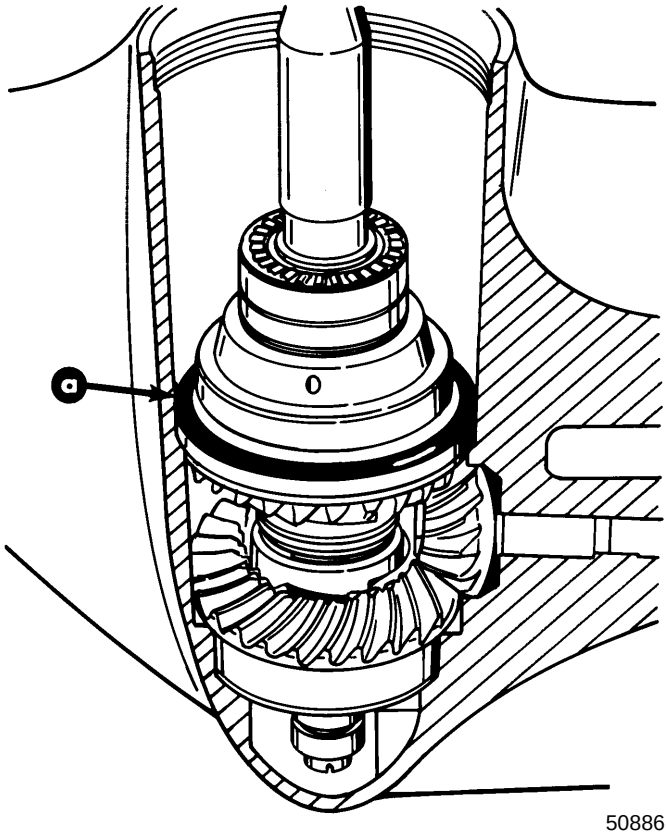
16. Apply gear lube to second thrust bearing and install on top of thrust collar.



50786

a - Thrust Bearing

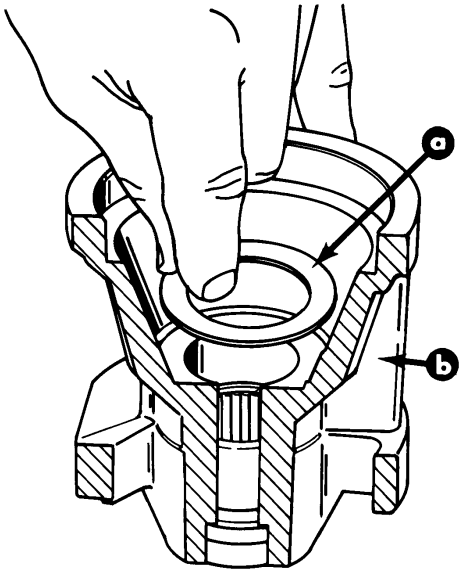
17. Lubricate O-ring with gear lube and install in gear housing as shown. Push down in groove.



50886

a - O-ring

18. Apply gear lube to second small thrust race and stick it to surface inside of bearing carrier.



50779

a - Thrust Race
b - Bearing Carrier

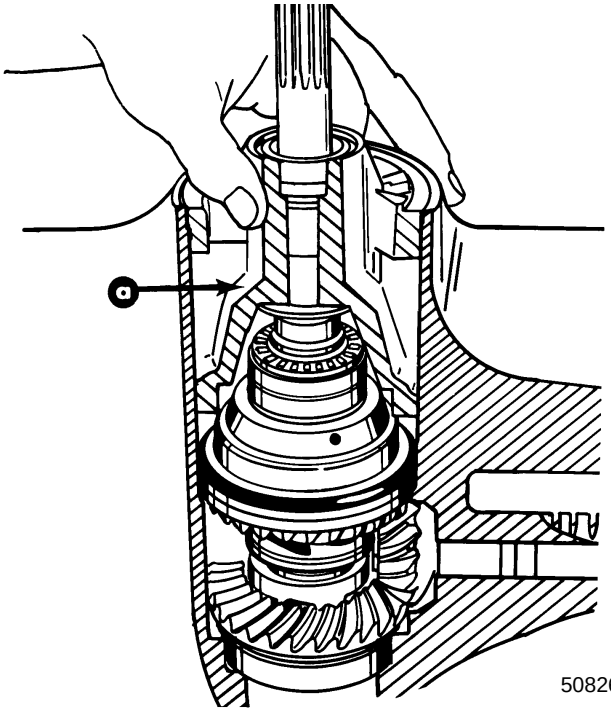
19. Install bearing carrier as follows:

    a. Coat gear housing contact surfaces with Special Lubricant 101.

    b. Lubricate needle bearing with gear lube.

    c. Fill area between seals with 2-4-C Marine Lubricant.

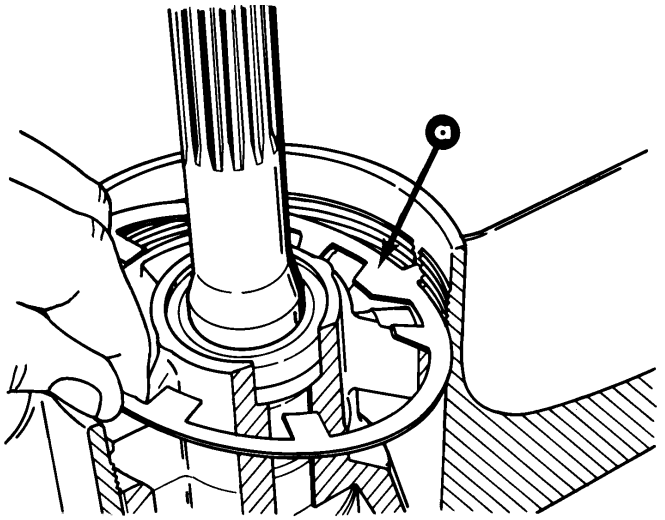
    d. Lower carrier into housing until fully seated.



50826

a - Bearing Carrier

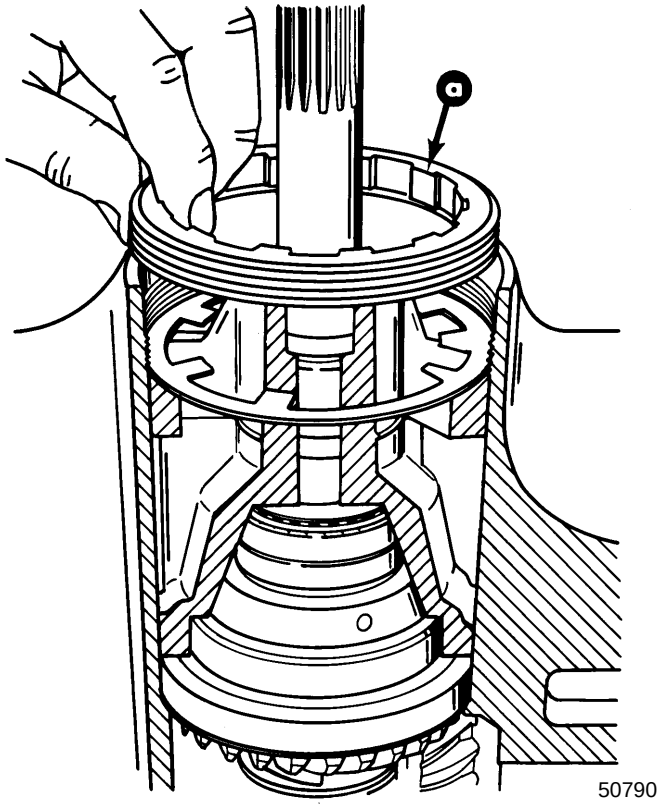
20. Install tab washer as shown.



50779

a - Tab Washer

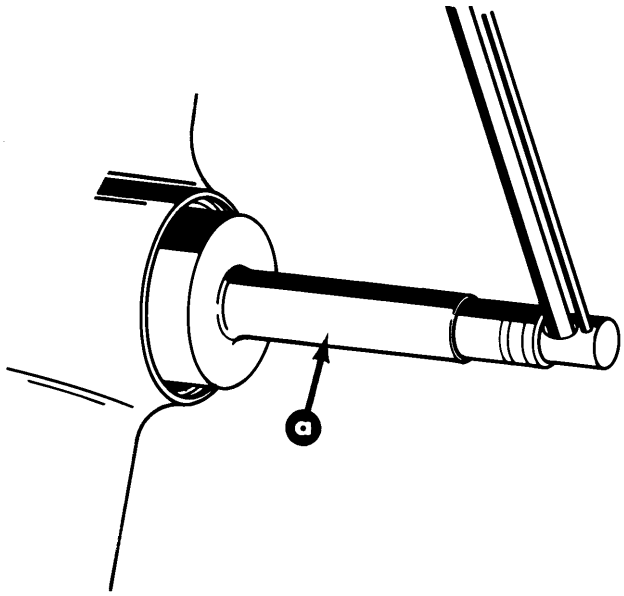
21. Apply Special Lubricant 101 to threads of bearing carrier retainer and install in gear housing.



50790

a - Bearing Carrier Retainer

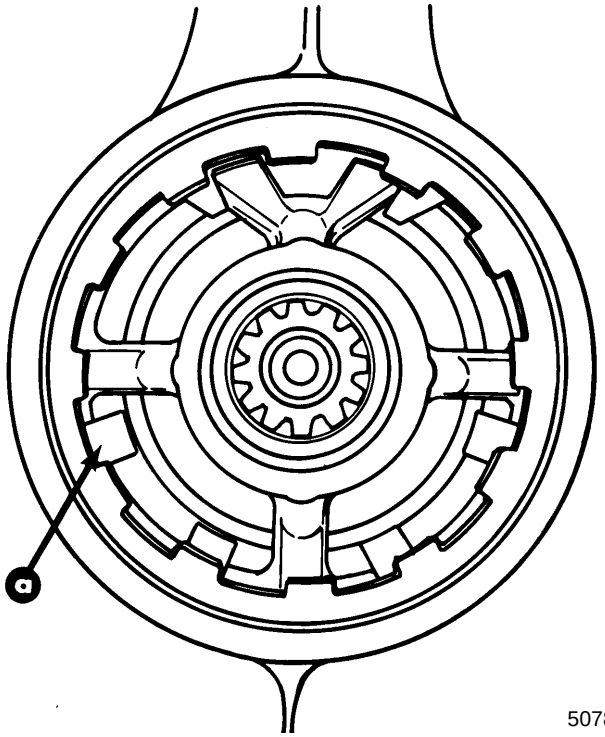
22. Torque bearing carrier retainer to 210 lb. ft. (285 N·m) using Bearing Carrier Retainer Wrench (91-61069). Tighten further if one tab does not line up in a notch in the bearing retainer.



23355

a - Wrench

23. Bend over tab up into notch in retainer and the remainder of tabs inward.

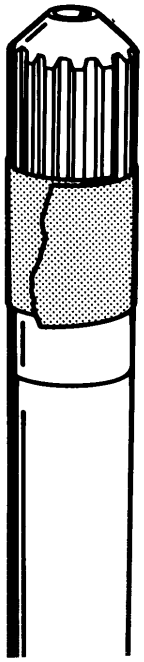


50784

a - Tab

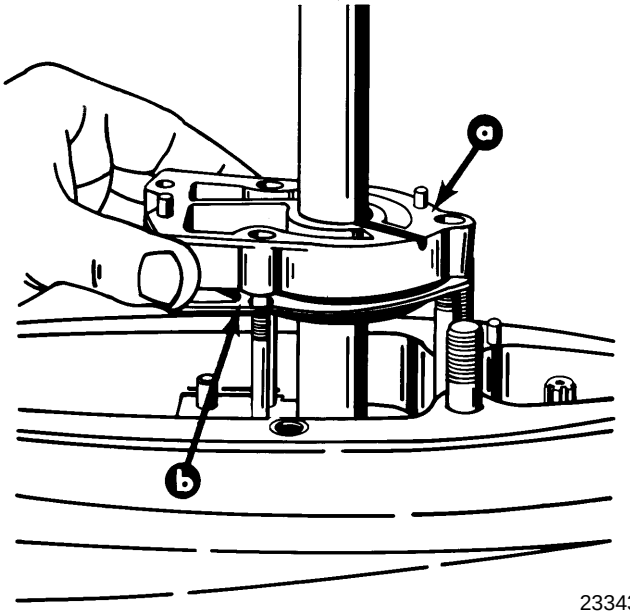
WATER PUMP INSTALLATION

1. On units with O-ring and O-ring groove, cover drive shaft O-ring groove with a piece of tape.



50312

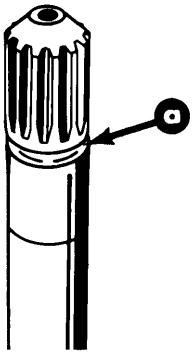
2. Lubricate water pump base, O-ring and oil seal lips with 2-4-C Marine Lubricant. Install water pump base and gasket over drive shaft.



23343

a - Water Pump Base
b - Gasket

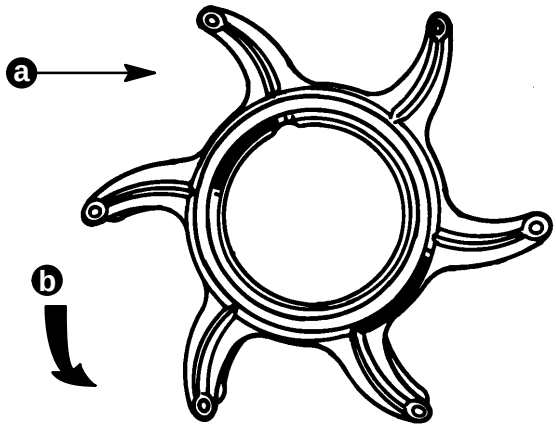
3. Remove tape from drive shaft O-ring groove.



23343

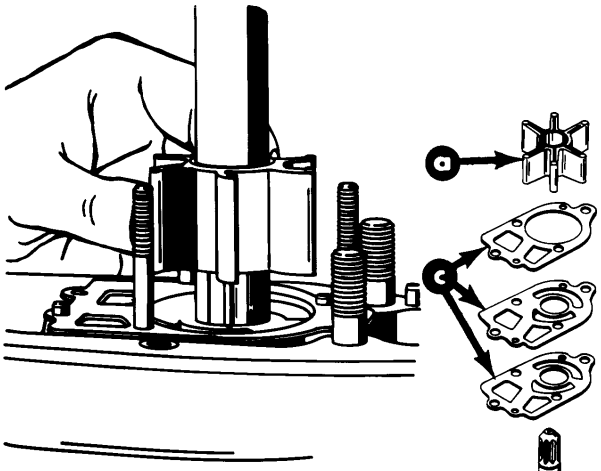
a - O-ring Groove (Not Found On Service Parts)

IMPORTANT: When completing repair which required removal of water pump impeller, it is recommended that the impeller be replaced. If it becomes necessary to reuse an impeller, DO NOT install reversed from original rotation, or premature impeller failure will occur. Face the curl of the blades in a counterclockwise direction.

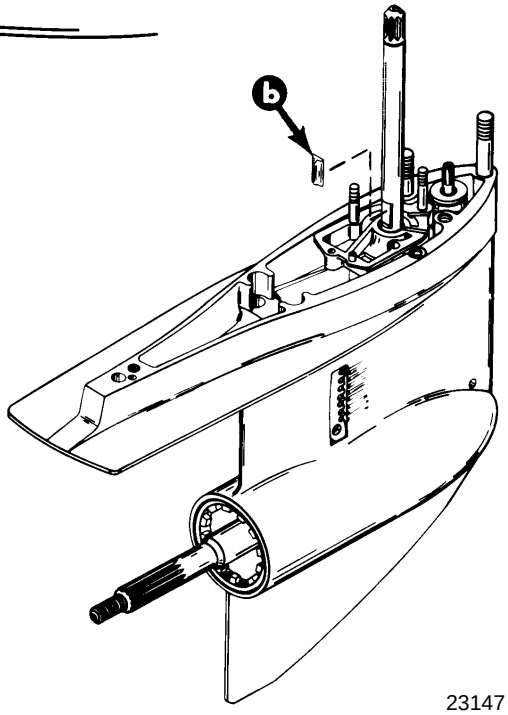


50312

4. Install gaskets and face plate with one gasket on each side of face plate and lip on face plate facing toward water pump base.
5. Place a small amount of 2-4-C Marine Lubricant on drive key and place key on flat of drive shaft.
6. Slide water pump impeller over drive shaft.
7. Align impeller key-way with key and set impeller on face plate.



23356

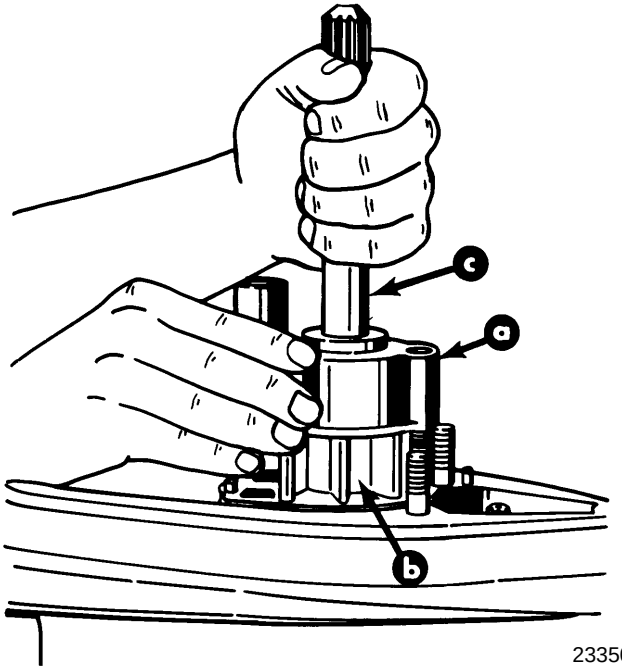


23147

a - Water Pump Impeller
b - Key
c - Water Pump Face Plate And Gaskets (One On Each Side)

8. Lightly lubricate water pump body insert with 2-4-C Marine Lubricant.

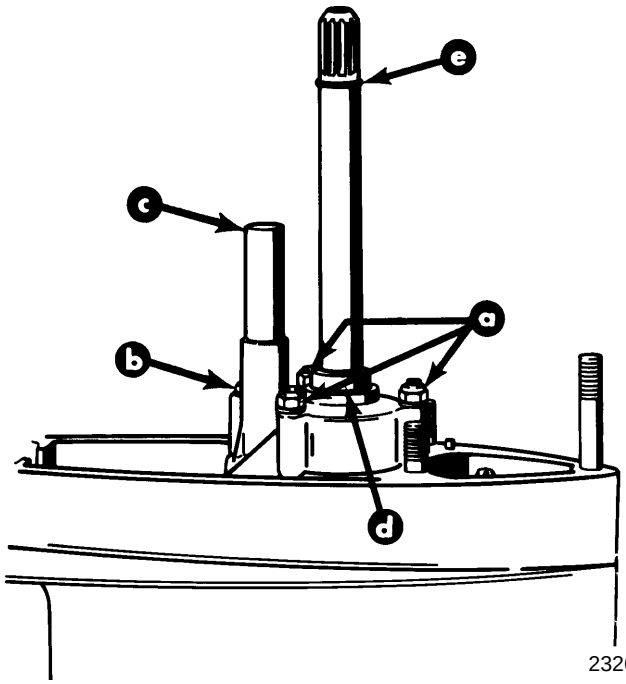
9. Position water pump body over drive shaft and water pump studs. Rotate drive shaft in a clockwise direction, while pushing down on water pump body to ease impeller entry into body.



23350

a - Water Pump Body
b - Water Pump Impeller
c - Drive Shaft

10. Install components as shown. Torque nuts to 60 - 80 lb. in. (6.8-9 N·m) and torque screw to 30 - 40 lb. in. (3.4-4.5 N·m).

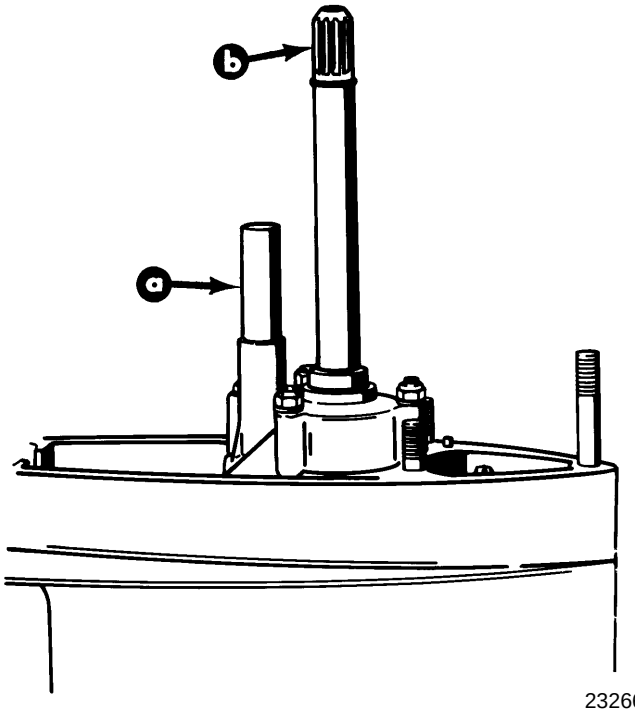


23266

a - Flat Washers and Nuts (3)
b - Screw
c - Water Tube (Plastic)
d - Centrifugal Slinger
e - O-ring (If O-ring Groove Is Present)

Gear Housing Installation

1. Lubricate end of water tube and drive shaft splines with 2-4-C Marine Lubricant. DO NOT lubricate top of drive shaft.

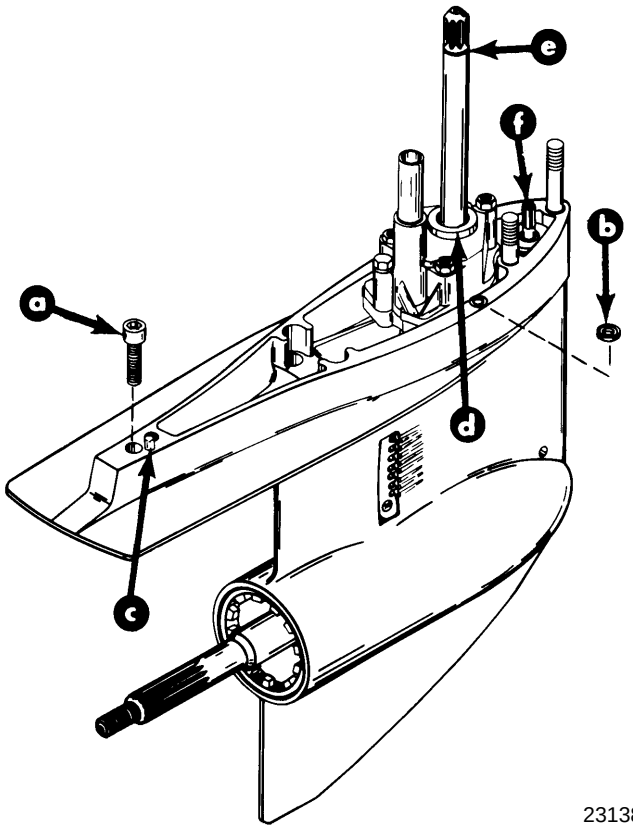


23266

a - Water Tube
b - Drive Shaft Splines

2. Install trim tab allen screw.
3. Install oil seal and apply Special Lubricant 101, 2-4-C Marine Lubricant, or Perfect Seal to oil seal.
4. Check that alignment pins, centrifugal slinger and drive shaft O-ring are in place.
5. Move gear housing shift shaft clockwise to shift gear housing into reverse.

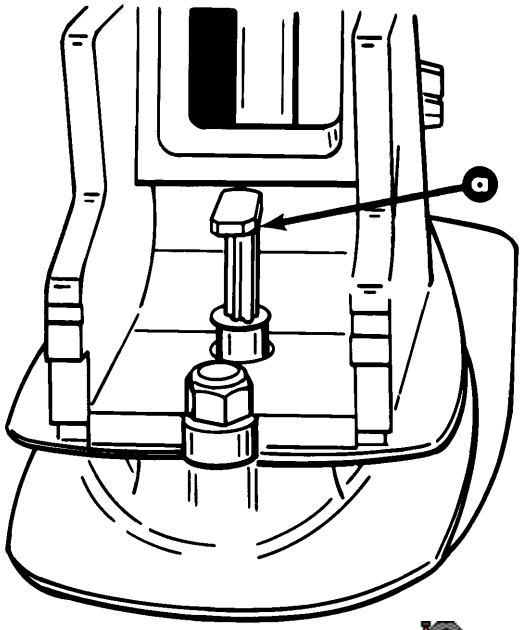
NOTE: *Gear housing may be held in reverse gear by applying light pressure to propeller shaft in a counter-clockwise direction.*



23138

a - Trim Tab Allen Screw
b - Oil Seal
c - Alignment Pins
d - Centrifugal Slinger
e - O-ring (If O-ring Groove Is Present)
f - Shift Shaft

6. Align intermediate shift shaft straight forward (parallel with propeller shaft).



23265

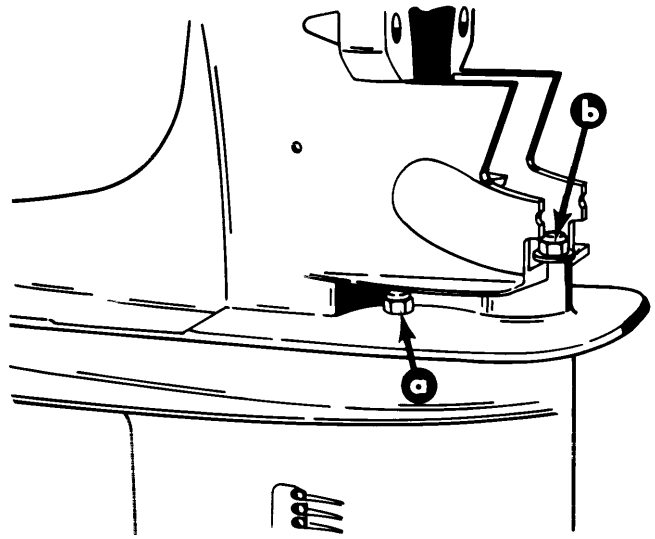
a - Shift Shaft

NOTE: *If propeller shaft is rotated in a clockwise direction before shift shafts are coupled, gear housing must be shifted back into reverse gear and held in position.*

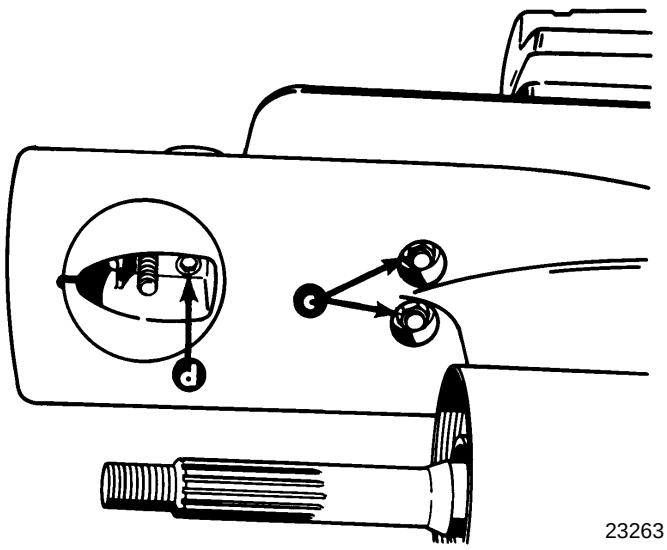
7. Align water tube with tube guide and drive shaft and shift shaft splines with upper drive shaft and shift shaft splines and install gear housing. Check for proper operation of shift shaft.

NOTE: *Rotate propeller shaft counterclockwise only after shift shaft splines have engaged. This will help engage drive shaft splines.*

8. Secure gear housing to drive shaft housing as shown. Torque locknuts to 35 lb. ft. (48 N·m). Torque allen screw to 28 lb. ft. (38 N·m).



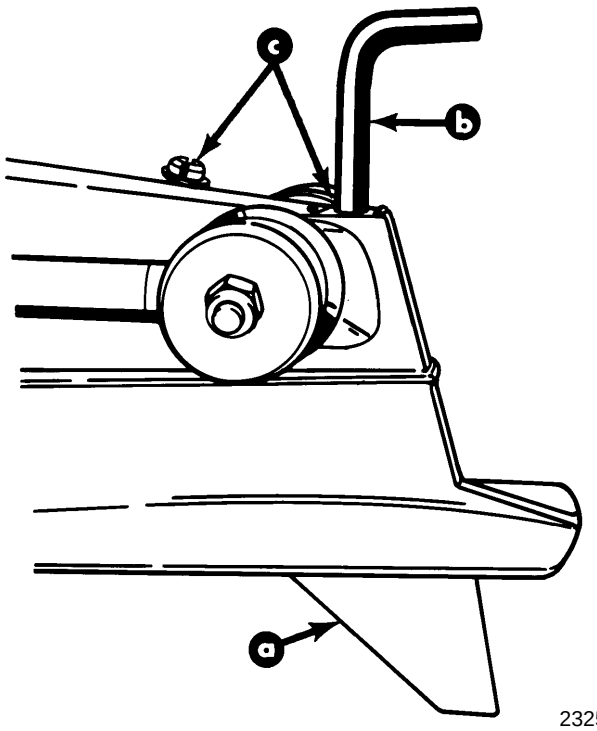
23261



23263

a - Locknuts (One Each Side)
b - Locknut
c - locknuts
d - Allen Screw

9. Install trim tab and position according to marks made before disassembly. Torque to 30 lb. ft. (40 N·m). Reinstall plastic plug.



23253

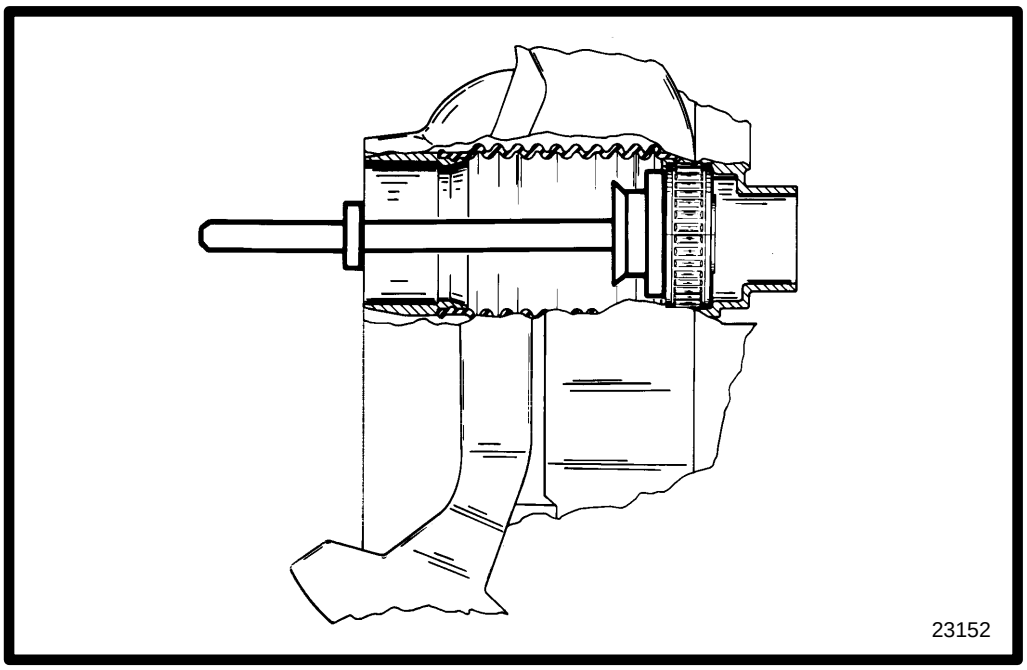
a - Trim Tab
b - Allen Wrench
c - Plastic Plug

10. Refill drive unit with gear lubricant (Refer to Section 1-B).

TRANSOM ASSEMBLY

4

A



SERVICE PROCEDURES REQUIRING MINOR DISASSEMBLY

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Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Shift Cable Core Wire Anchor Screws	20		2.3
Bellows Clamps	35		4

Lubricants/Sealers/ Adhesives

Description	Part No.
3M Adhesive	92-86166-1
2-4-C Marine Lubricant	92-825407A2
Liquid Neoprene	92-25711--2
Locquic Primer “T”	92-59327-1
Loctite 27131	92-809820

Special Tools

Description	Part No.
Bearing Removal and Installation Tool	91-31229A7
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Shift Cable Removal and Installation Tool	91-12037

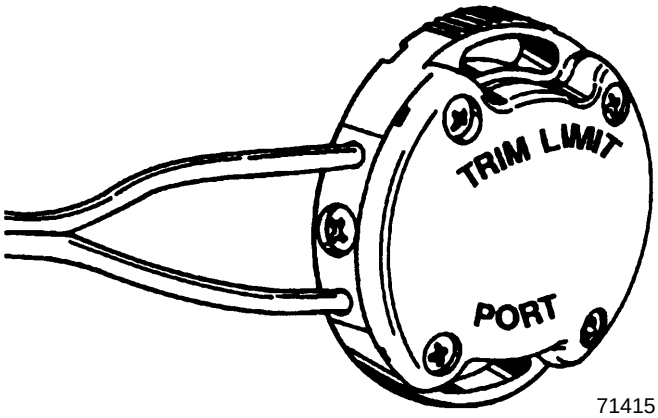
Special Information

Trim Limit Switch

Transom assembly serial number 6271054 and above.

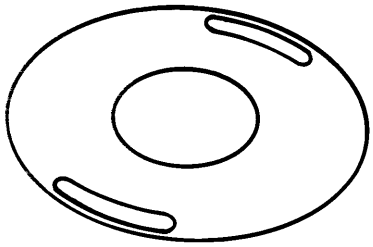
The newer style trim limit switch has a new sealing system for improved water resistance and durability. The trim limit switch leads are connected internally on the newer style switch to help ensure good electrical integrity.

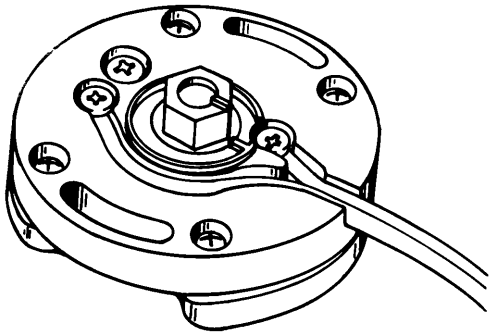
NOTE: *Insulator used with older style switch is not required when using newer style switch.*



71415

Newer Style Trim Limit Switch





22160

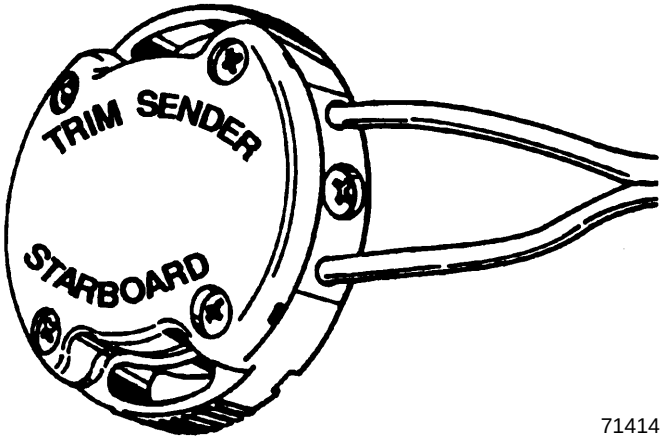
Older Style Trim Limit Switch

New Trim Position Sender

The newer style trim position sender has a new sealing system for improved water resistance and durability. The sender leads are connected internally on the newer style sender to help ensure good electrical integrity.

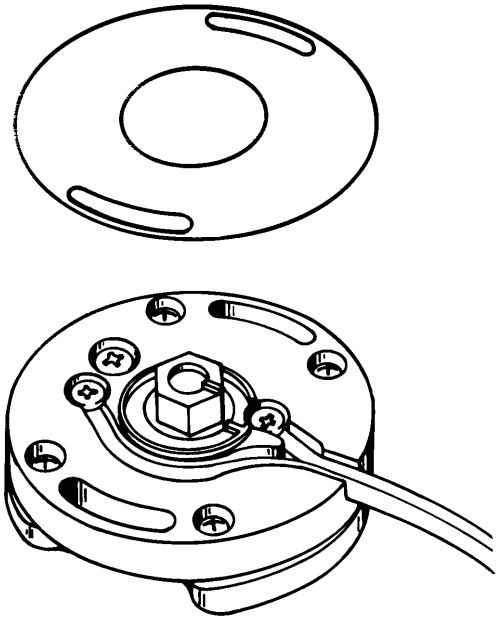
NOTE: *Insulator used on older style sender is not required when using newer style sender.*

The newer style trim position sender is used as a replacement part for all MerCruiser I-MR and Alpha One models. Trim position sender leads are provided with the newer sender and are pre-connected at the factory.



71414

New Style Trim Position Sender



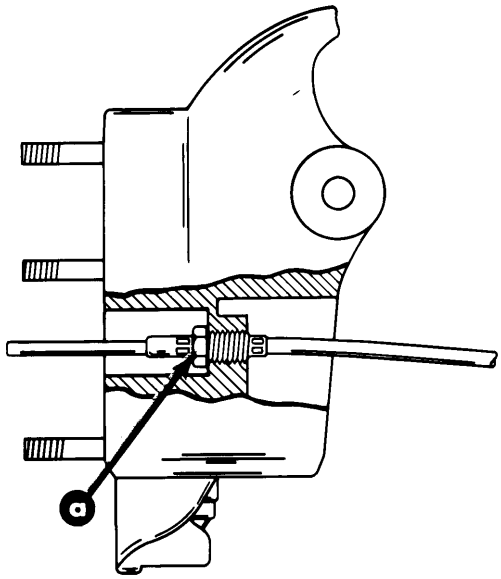
22160

Older Style Trim Position Sender

Shift Cable

Transom assembly serial number 6376504 and above.

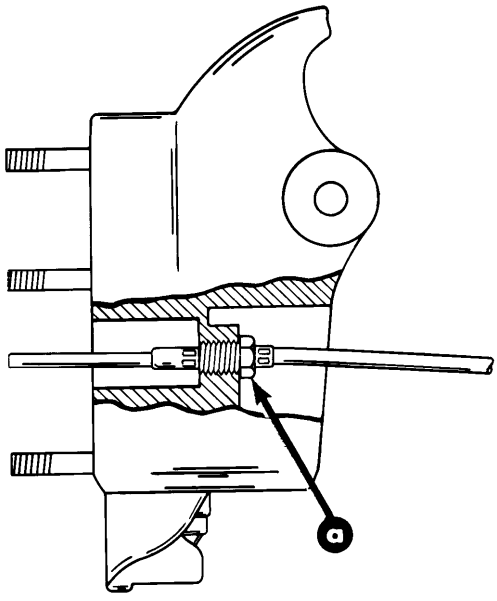
A new style drive unit shift cable attaches to the bell housing from the aft end (rather than the front end as did the old style cable) for easier removal and installation. With the exception of the cable attaching method, the installation and adjustment procedure is the same as the old style cable. A Drive Unit Shift Cable Removal and Installation Tool 91-12037 is required for cable removal and installation.



23156

New Style Shift Cable

a - Shift Cable Retaining Nut



23169

Old Style Shift Cable

a - Shift Cable Retaining Nut

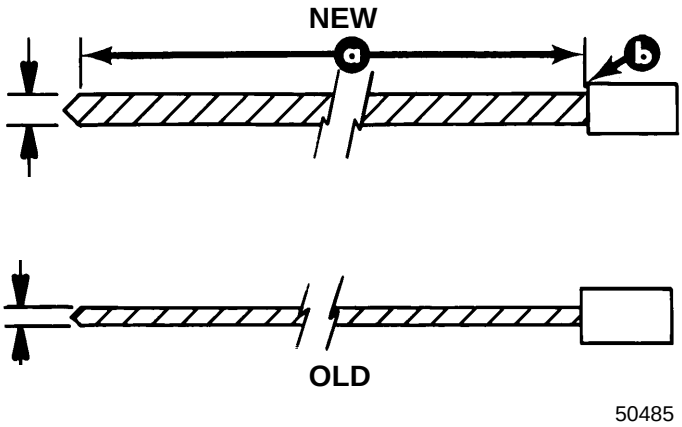
The new style cable can be used on all MerCruiser models.

Transom assembly serial number 0C698141 and above.

A new style drive unit shift cable is being used. Following is a list of the major differences from the earlier cable.

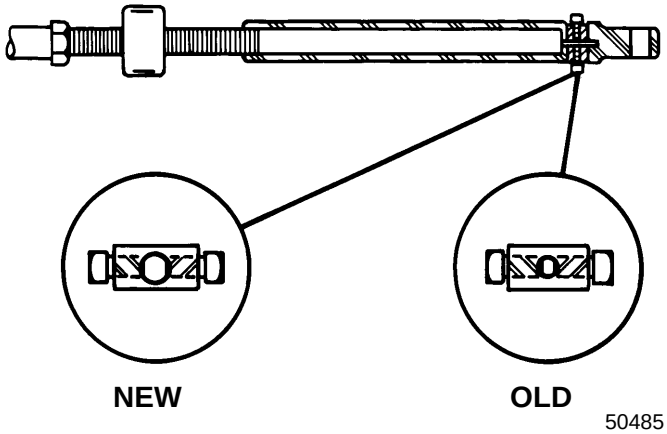
IMPORTANT: The new style shift cable will be pre-cut to proper length and should be replaced as an assembly only. DO NOT mix parts between old and new style.

1. Larger Diameter Armor Wrapped Core Wire.
2. Larger Diameter Hole in Shift Cable Anchor.
3. Larger Diameter Hole Inside of Shift Slide.
4. Larger Diameter Shift Cable Conduit (To Accommodate Larger Diameter Core Wire).

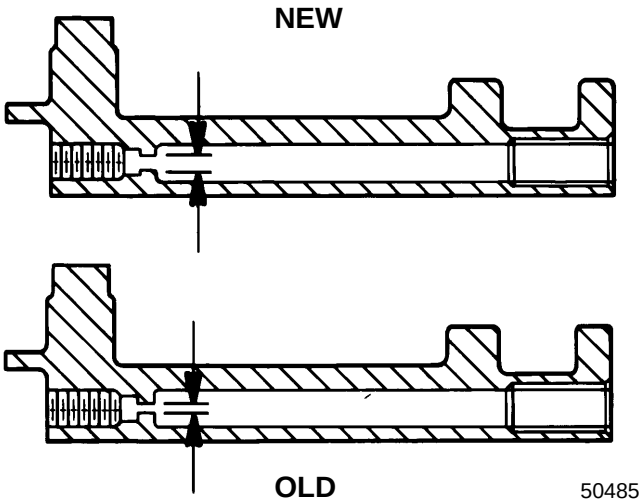


Core Wires

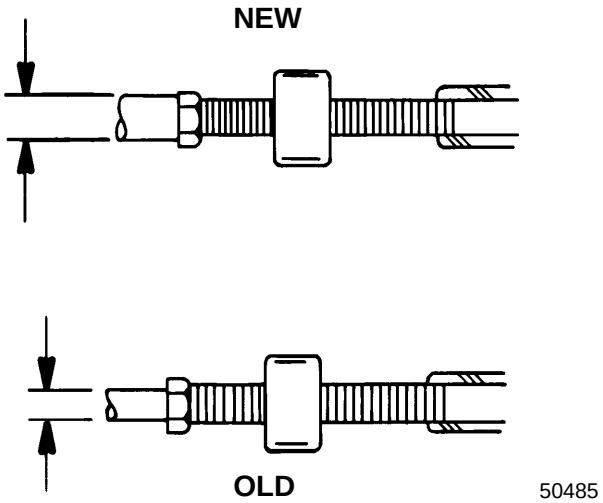
a - New Pre-Cut Core Wire Dimension 72-1/8 in. (1832 mm)
b - Front Edge of Anchor



Cable Anchors



Shift Slides

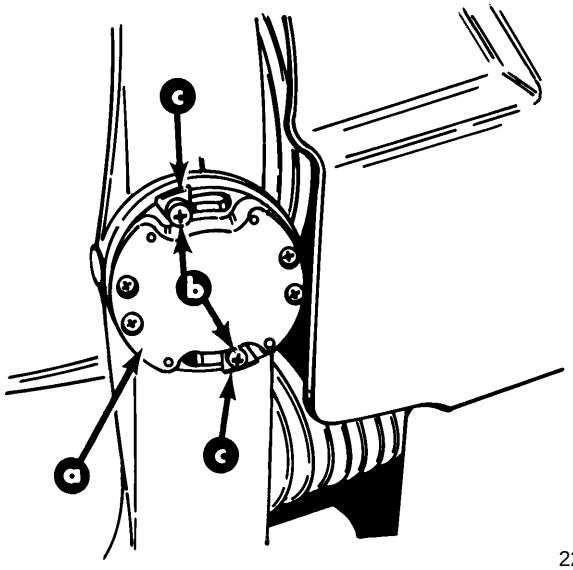


Shift Cable Conduit

Trim Position Sender (Earlier Style)

REMOVAL

1. Remove trim position sender.

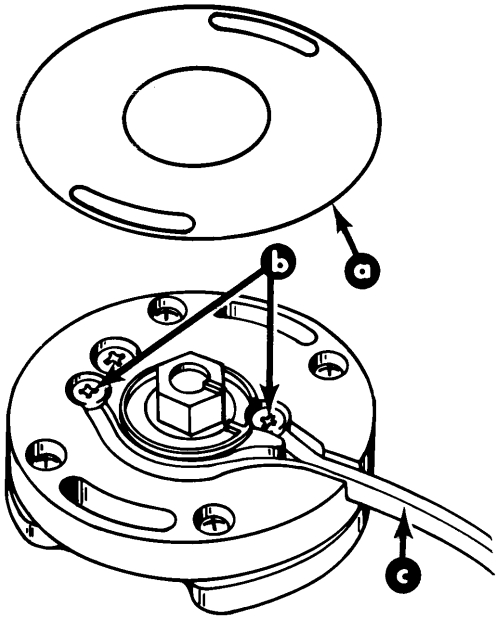


22091

a - Trim Position Sender
b - Screws (2)
c - Retainer (2)

DISASSEMBLY

1. Remove insulator and disconnect wires.



22160

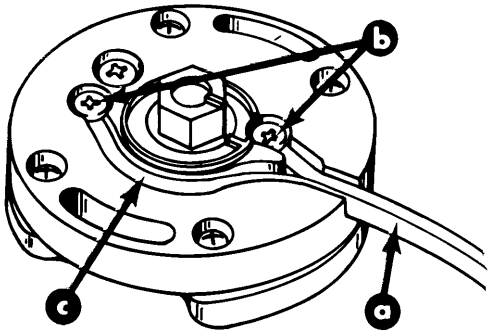
a - Insulator
b - Screws
c - Wires

INSPECTION

1. Inspect switch for cracks or other signs of damage.
2. Inspect wires for chafing, cuts and cracks in insulation.
3. Inspect quad ring seals on rotor assembly for twisting and damage.

REASSEMBLY

1. Install wires with two screws and tighten securely. Fill grooves with insulating compound.

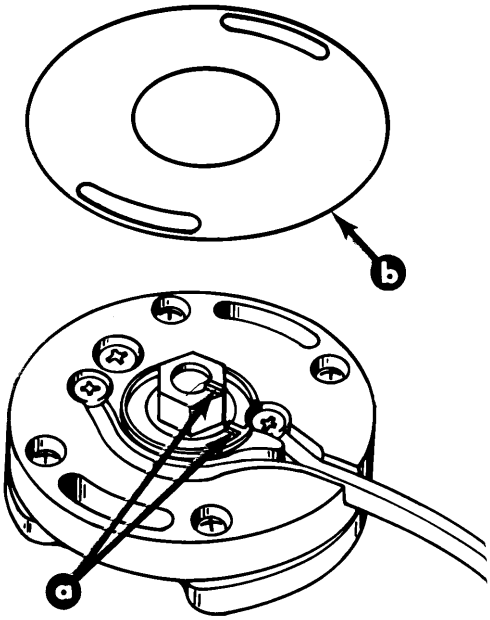


22160

a - Wires
b - Screws
c - Grooves

INSTALLATION

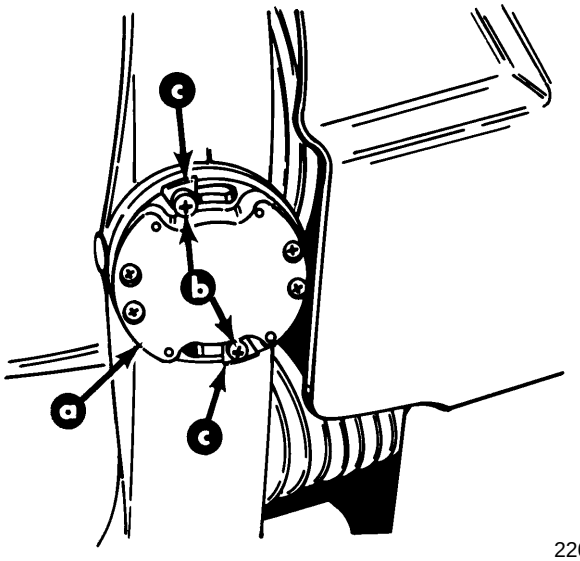
1. Align index marks and install insulator.



22160

a - Index Marks
b - Insulator

2. Install trim position sender. Ensure insulator slot aligns with slot in sender.



22091

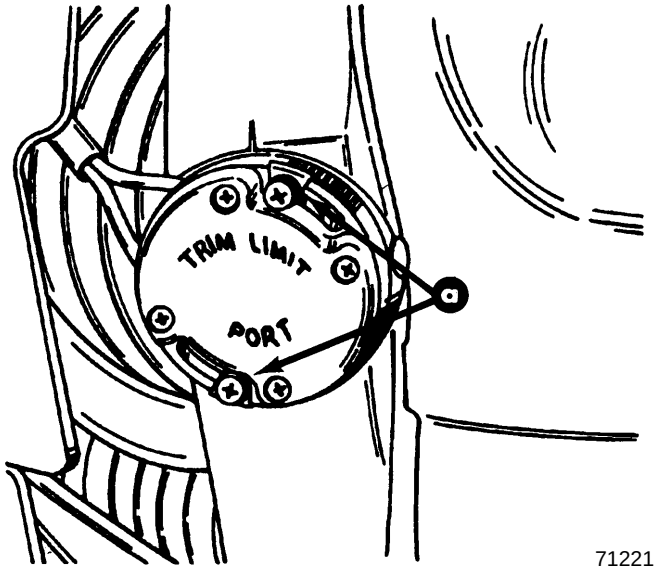
a - Trim Position Sender
b - Screws (2)
c - Retainer (2)

Trim Position Sender and Trim Limit Switch Replacement

⚠ WARNING

Disconnect both battery cables before installing new trim limit switch or trim sender.

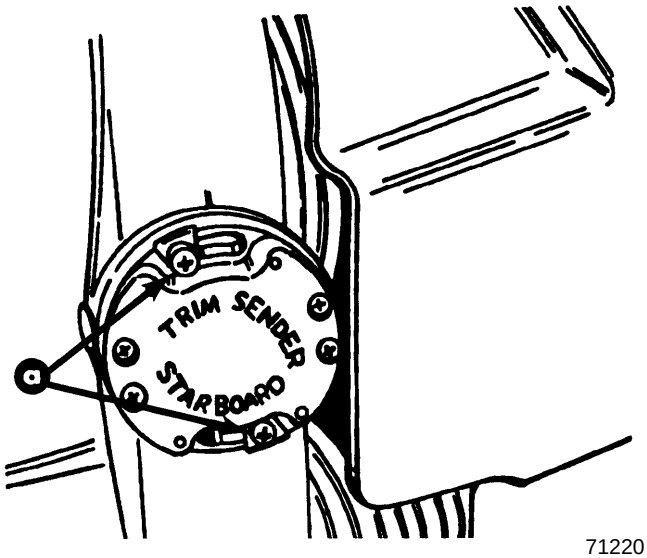
1. Remove sterndrive unit.
2. Remove trim limit switch.



71221

a - Screws, Washers and Retainers

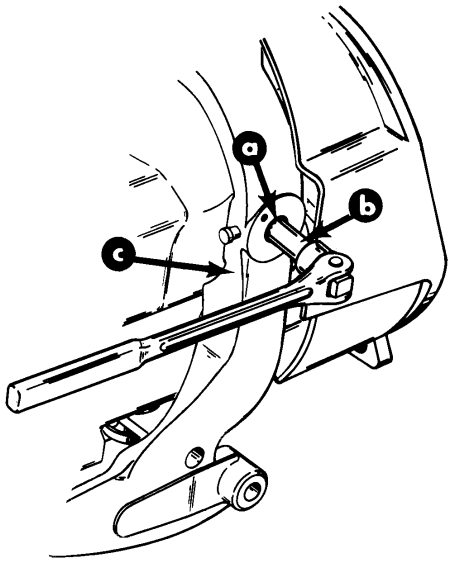
3. Remove trim position sender. This style cannot be repaired, but must be replaced as a single unit.



71220

a - Screws, Washers And Retainers

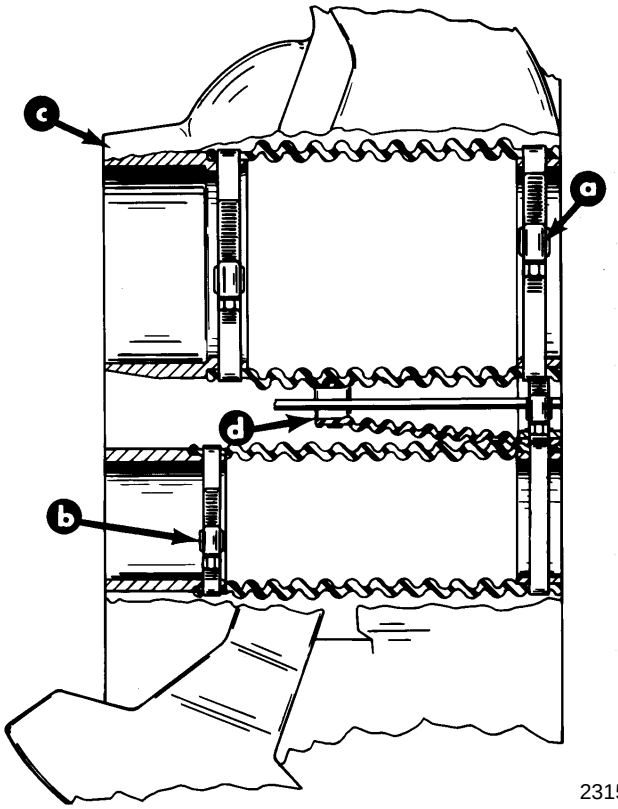
4. Remove hinge pins. Apply heat to bell housing, if necessary, to soften Loctite.



23292

a - Hinge Pins
b - Hinge Pin Tool
c - Apply Heat Here

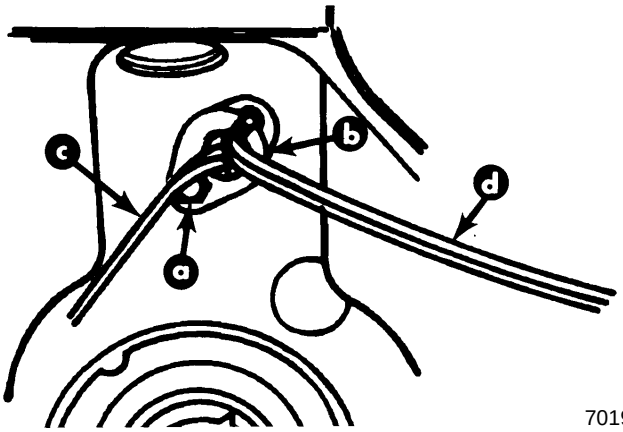
5. Remove bell housing as follows:
   a. Loosen U-joint bellows front hose clamp.
   b. Loosen exhaust bellows rear hose clamp.
   c. Pull bell housing away from gimbal housing.
   d. Pull shift cable through shift cable bellows.



23158

a - U-joint Bellows Front Hose Clamp
b - Exhaust Bellows Rear Hose Clamp
c - Bell Housing
d - Shift Cable Bellows

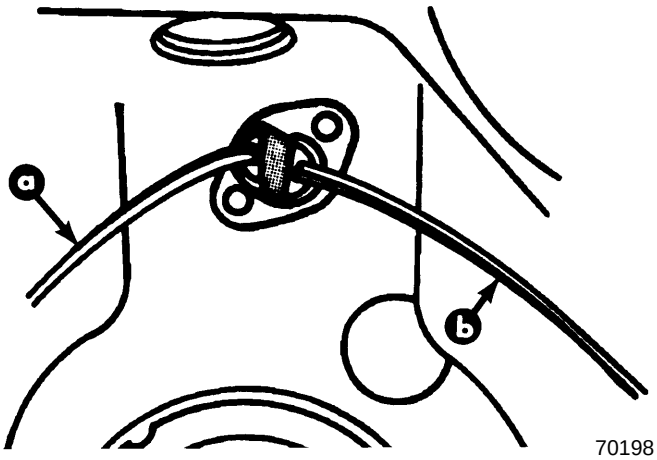
6. Remove trim harness clamp.
7. Remove trim limit switch wires and trim position sender wires.



70197

a - Screw
b - Trim Harness Clamp
c - Trim Limit Switch Wires
d - Trim Position Sender Wires

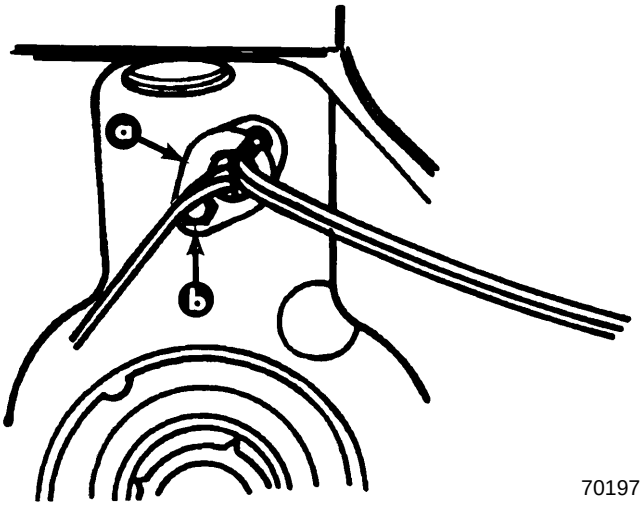
8. Install trim limit switch wires and trim position sender wires. DO NOT pinch wires.



70198

a - Trim Limit Switch Wires
b - Trim Position Sender Wires

9. Apply Perfect Seal to threads of screw and install trim harness clamp and screw. Torque to 90-100 lb. in. (10-11 N·m).



70197

a - Trim Harness Clamp
b - Screw

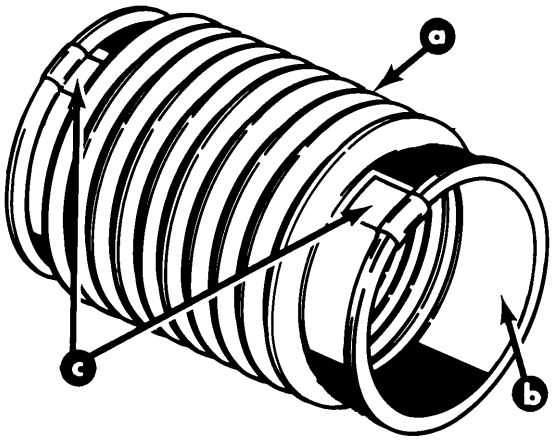
Bell Housing Installation

1. Install U-joint bellows on bell housing as follows:
   a. Clean mounting flange with sandpaper and wipe clean with lacquer thinner.

⚠ WARNING

Be sure to read and follow package label directions when using bellows adhesive.

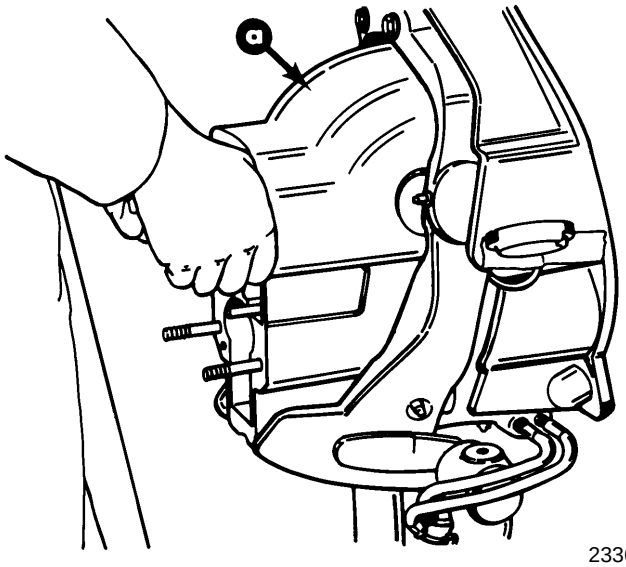
   b. Apply bellows adhesive to mounting surface on inside of bellows.
   c. Position grounding clip clamp over bellows on bell housing end.
   d. Install U-joint bellows on bell housing flange and tighten clamp.
2. Install exhaust bellows on gimbal housing as follows:
   a. Clean mounting flange with sandpaper and wipe clean with lacquer thinner.
   b. Apply bellows adhesive to mounting surface on inside of bellows.
   c. Position grounding clip on bellows.



22079

a - Exhaust Bellows
b - Mounting Surface
c - Ground Clip

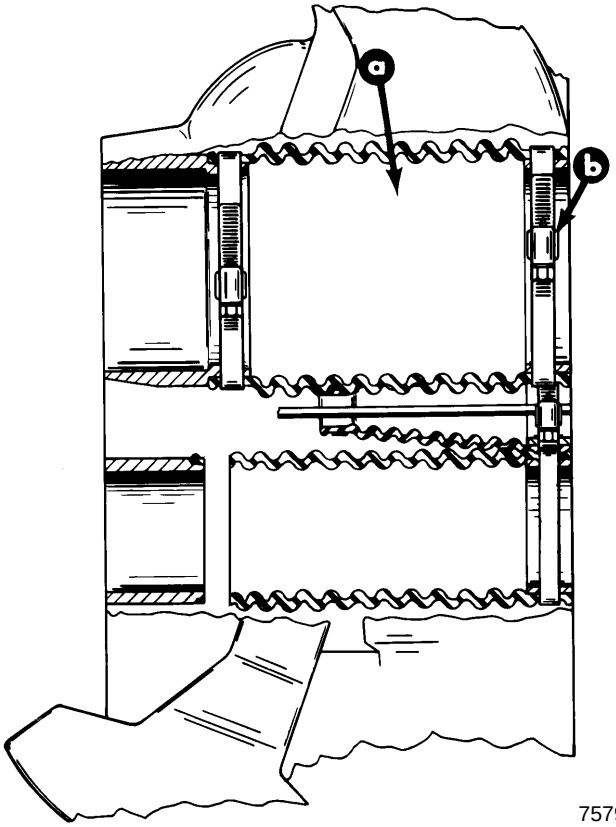
   d. Place both clamps over bellows end.
   e. Tighten clamp on gimbal housing end. Leave remaining clamp loose on bellows.
3. Install bell housing between gimbal ring. Push on bell housing and guide U-joint bellows onto gimbal housing mounting flange.



23363

a - Bell Housing

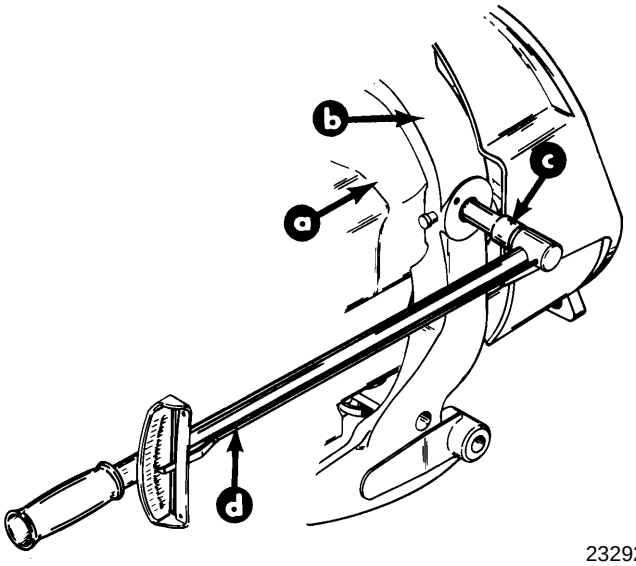
4. Position U-joint bellows hose clamp as shown and tighten securely.



75792

a - U-joint Bellows
b - Hose Clamp

5. Apply Locquic Primer “T” to internal bell housing threads and external hinge pin threads and allow to dry. Apply Loctite 27131 to bell housing threads and install hinge pins. Torque hinge pins to 95 lb. ft. (129 N·m).

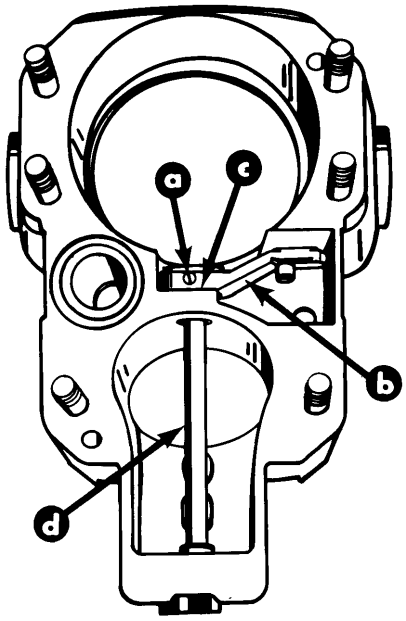


23292

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (P/N 91-78310)
d - Torque Wrench (lb. ft.)

6. Remove upper shift shaft lever and shift shaft.

NOTE: *It may be necessary to apply heat to shift shaft lever screw to aid in removing.*

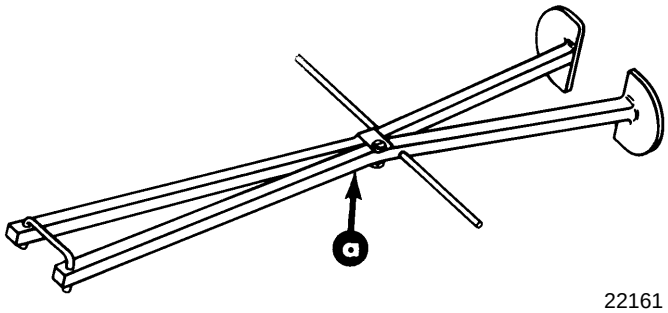


23362

a - Upper Shift Shaft Lever Screw
b - Upper Shift Shaft Lever
c - Washer (Beneath Lever)
d - Upper Shift Shaft

7. Install exhaust bellows on bell housing as follows:

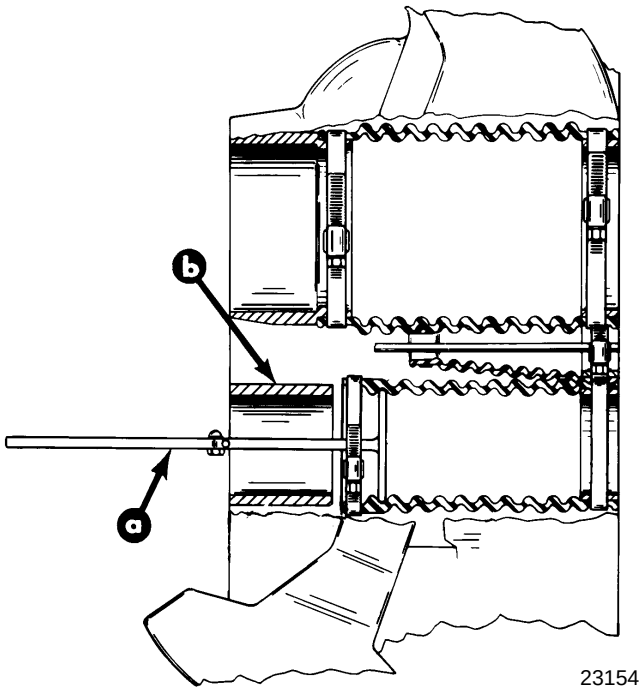
   a. Place Expander Tool (91-45497A1) into first bellows convolution.



22161

a - Expander Tool

   b. Pull tool until tool touches the mounting flange on bell housing (bellows starts to slip onto flange). Release tool.



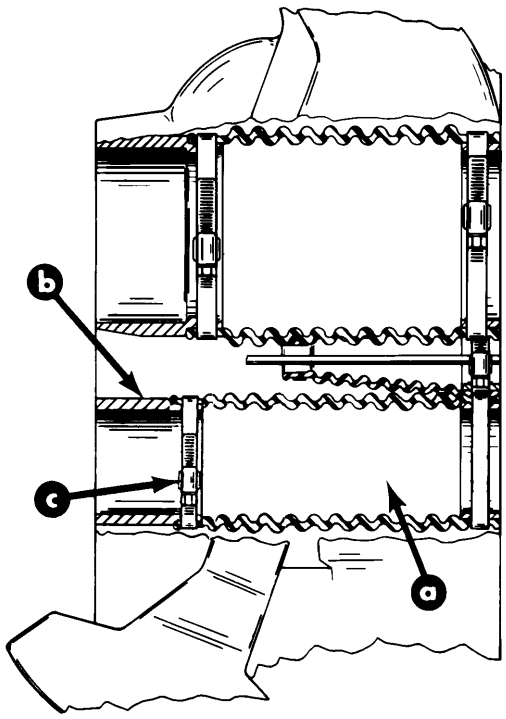
23154

a - Expander Tool
b - Bell Housing Flange

   c. Reposition tool into the third bellows convolution.

   d. Pull bellows onto bell housing flange.

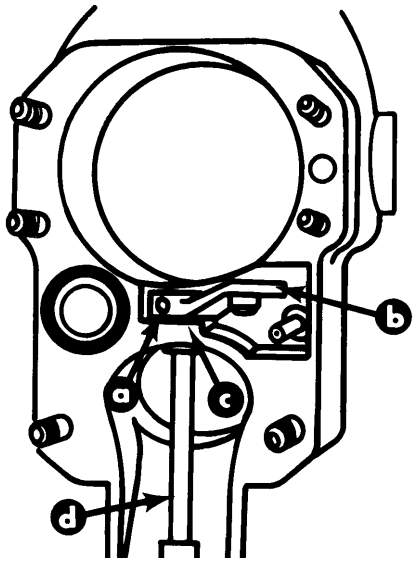
e. Position hose clamp as shown and tighten securely. Remove tool.



23158

a - Exhaust Bellows
b - Bell Housing Flange
c - Hose Clamp

8. Install upper shift shaft lever and shift shaft. Apply Loctite 27131 to screw threads. Tighten securely.

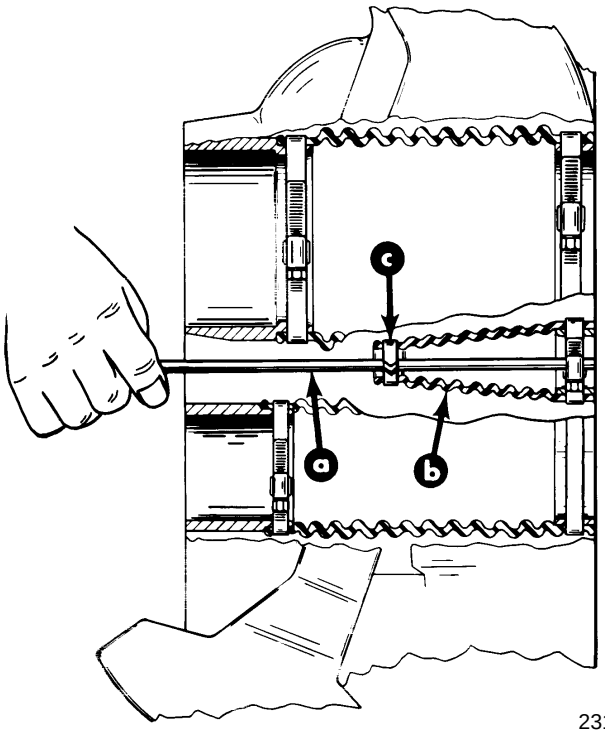


70141

a - Upper Shift Shaft Lever Screw
b - Upper Shift Shaft Lever
c - Washer (Beneath Lever)
d - Upper Shift Shaft

IMPORTANT: Ensure shift cable bellows crimp clamp is not flattened out when compressing in the following step. Crimp clamp must be compressed evenly around bellows and shift cable to prevent water leakage.

9. Insert shift cable through shift cable bellows and compress crimp clamp.

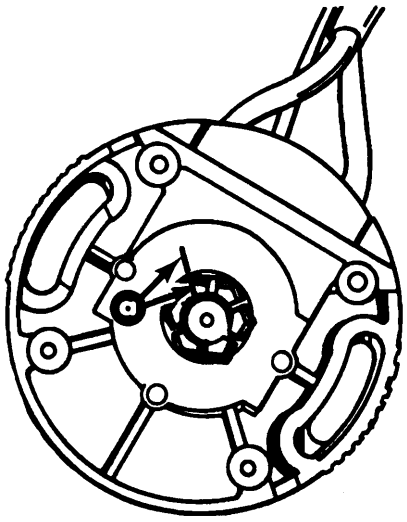


23155

a - Shift Cable
b - Shift Cable Bellows
c - Crimp Clamp

Trim Position Sender Installation

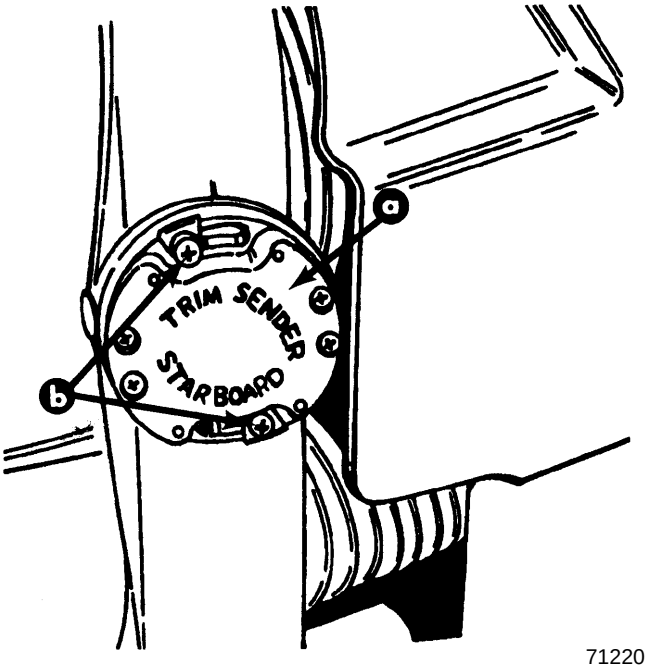
1. Install trim position sender as follows:
   a. Place sterndrive unit in the full DOWN/IN position.
   b. Turn center rotor of trim position sender to align index mark with index mark on sender body.



71218

a - Index Marks

2. Install trim position sender. Ensure insulator slot aligns with slot in sender.

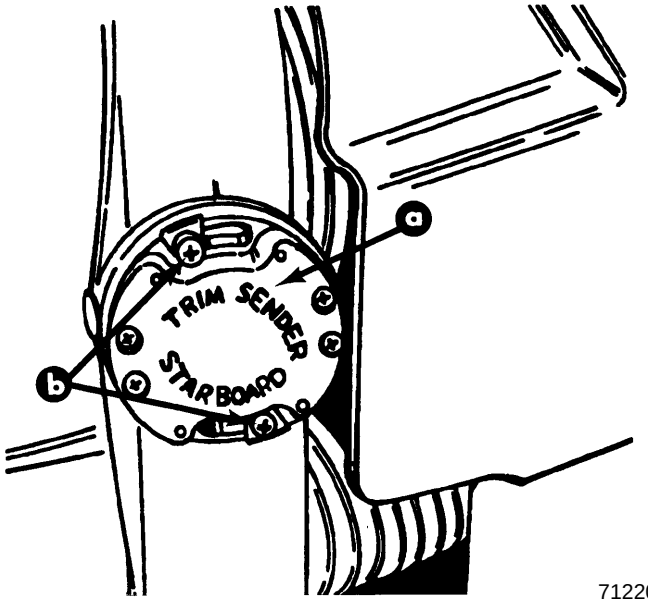


71220

a - Trim Position Sender
b - Screws (2) And Retainer (2)

Trim Position Sender Adjustment (Early and Later Styles)

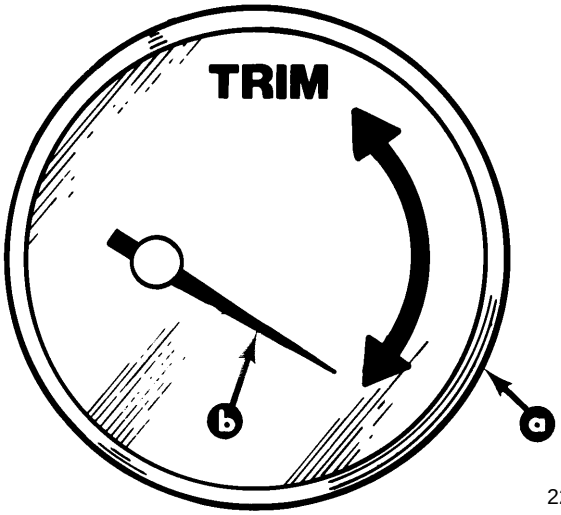
1. Place drive unit in the full DOWN/IN position.
2. Loosen trim position sender screws.



71220

a - Trim Position Sender
b - Screws

3. Turn ignition key to the “RUN” position. DO NOT START ENGINE.
4. Rotate sender until needle is at bottom of arc.



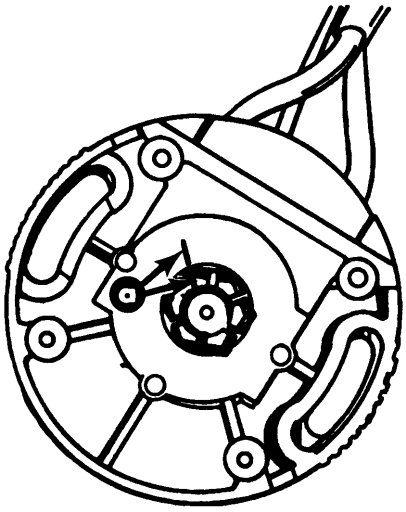
22175

a - Typical Trim Gauge
b - Needle

5. Tighten screws and recheck gauge reading.

Trim Limit Switch Installation

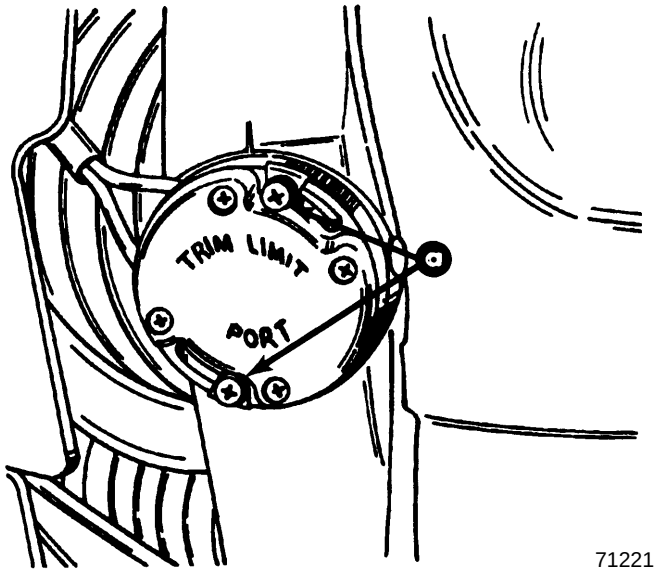
1. Align index marks on switch.



71218

a - Index Marks

2. Install trim limit switch.



71221

a - Screws, Washers And Retainers

Trim Limit Switch Adjustment

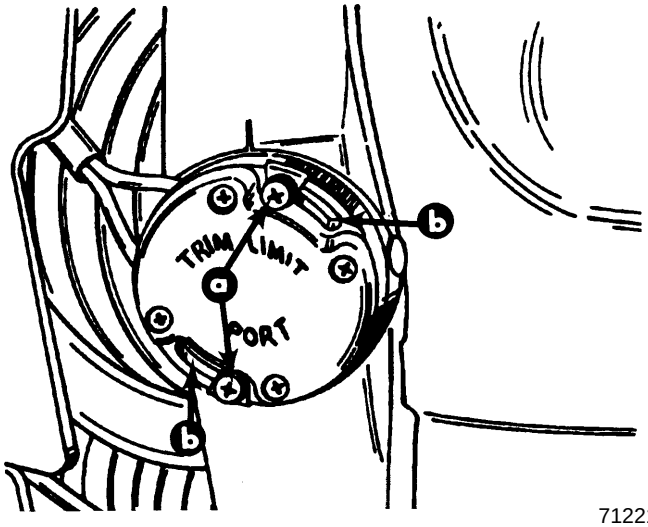
⚠WARNING

When adjusting trim limit switch, use extreme care that engine is not started and keep clear of area near propeller. Use care to prevent placing hands in an area where injury could occur because of drive unit movement.

⚠CAUTION

Trim limit switch MUST BE adjusted exactly as outlined. If switch is adjusted incorrectly, drive unit could move out beyond the gimbal ring support flanges and cause damage to sterndrive unit.

1. Loosen screws and turn trim limit switch clockwise to end of slots.

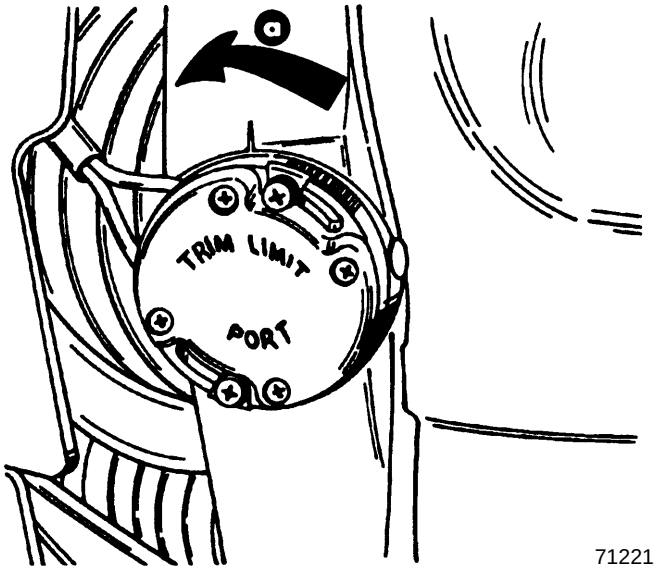


71221

a - Screws
b - Slots

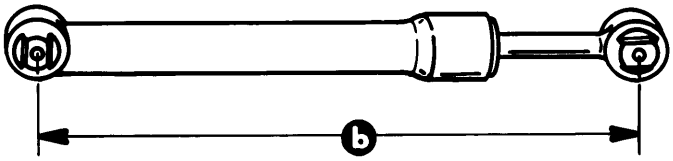
2. Place drive unit in the full DOWN/IN position.
3. Trim drive unit UP/OUT. Do not use trailer switch.

4. Slowly turn trim limit switch counterclockwise until trim cylinders extend to dimension shown.



71221

a - Rotate Counterclockwise To Adjust



50464

b - 21-3/4 in. ± 1/4 in. (554 mm ± 6 mm)

Gimbal Bearing

IMPORTANT: Gimbal bearing and carrier are a matched set and must be replaced as an assembly. Tolerance ring must be replaced anytime gimbal bearing is removed.

INSPECTION

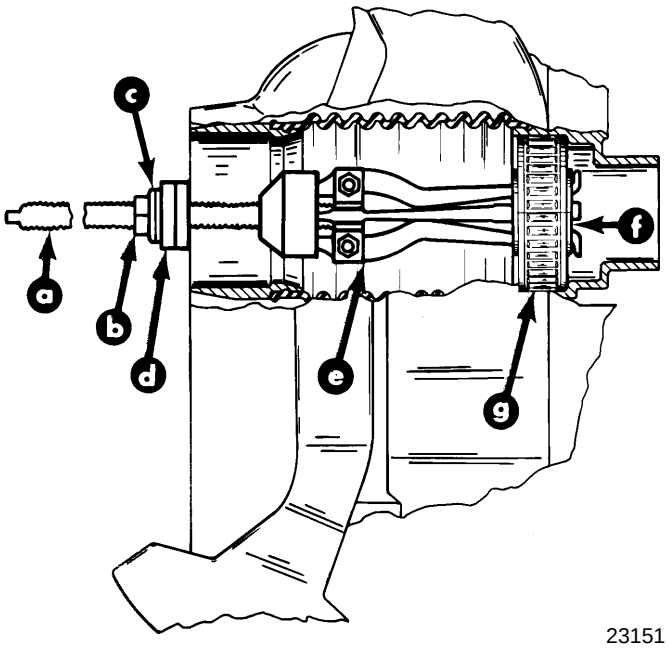
1. Remove sterndrive unit (Refer to Section 2A).
2. Reach through bell housing and rotate gimbal bearing to check for rough spots. Push and pull on inner race to check for side wear. Any excessive movement or roughness is cause for replacement.

REMOVAL

⚠CAUTION

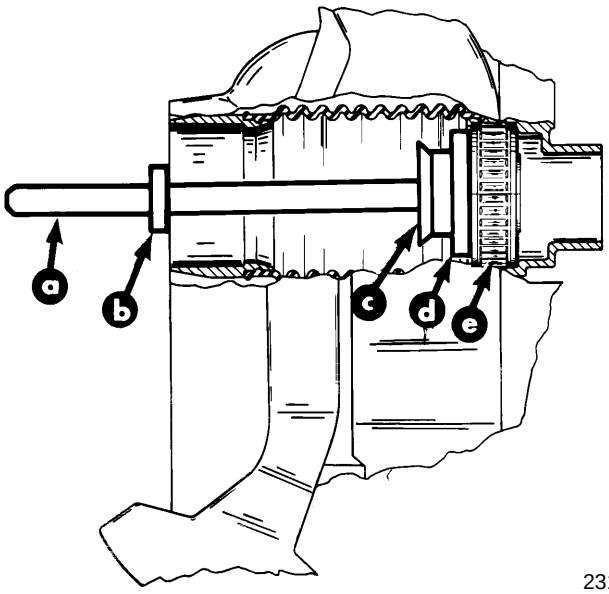
Do not remove gimbal bearing unless replacement is necessary, as damage to bearing may result during removal.

1. Remove gimbal bearing assembly using tools as shown.



23151

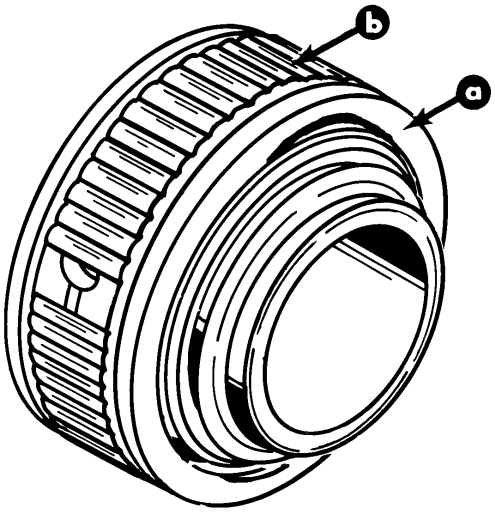
a - Puller Shaft (91-31229)*
b - Nut (11-24156)*
c - Washer (12-34961)*
d - Plates (2) (91-29310)
e - Slide Hammer Puller
f - Gimbal Bearing Inner Race
g - Gimbal Bearing Carrier
* From Bearing Removal And Installation Tool 91-31229A5



23152

a - Driver Rod (91-37323)*
b - Plate (91-29310)*
c - Driver Head (91-32325)*
d - Mandrel (91-30366-1)*
e - Gimbal Bearing Assembly
* From Bearing Removal And Installation Tool 91-31229A7

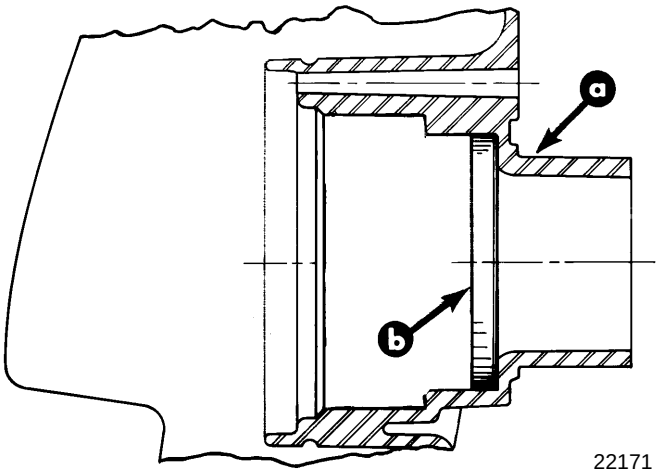
2. Remove tolerance ring.



22159

a - Gimbal Bearing Carrier
b - Tolerance Ring

3. Remove grease seal.

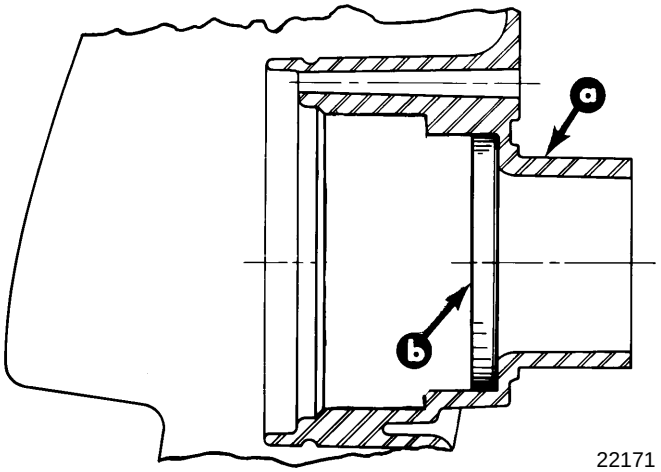


22171

a - Gimbal Housing
b - Grease Seal

INSTALLATION

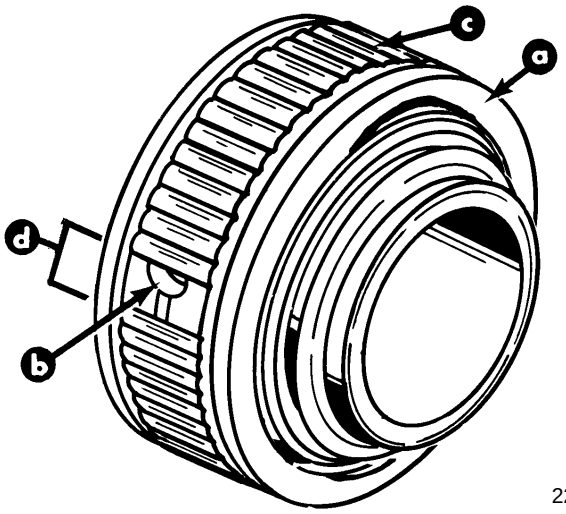
1. Install grease seal as shown.



22171

a - Gimbal Housing
b - Grease Seal

2. Install and position new tolerance ring as shown. Align opening in tolerance ring with grease hole in carrier.

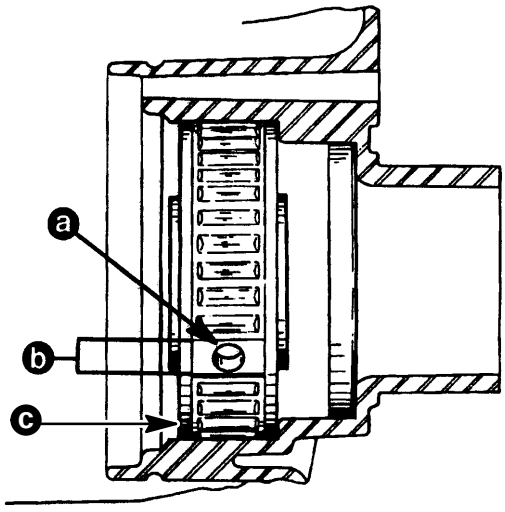


22159

a - Carrier
b - Carrier Grease Hole
c - Tolerance Ring
d - Opening In Tolerance Ring

IMPORTANT: Ensure that notched edge of bearing carrier faces inward in bore when installing gimbal bearing.

3. Align gimbal bearing carrier grease hole and tolerance ring opening with grease cavity hole in gimbal housing.



73668

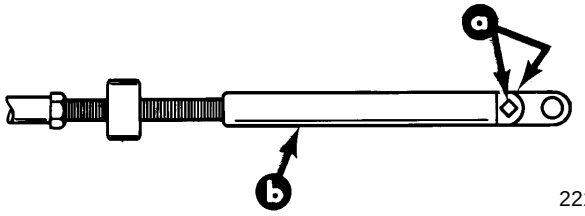
a - Gimbal Bearing Carrier Grease Hole
b - Tolerance Ring Opening
c - Bearing Bore

NOTE: *When fully installed, there must be at least 1/8 in. (3 mm) of bearing bore exposed behind bearing retainer.*

Shift Cable

REMOVAL

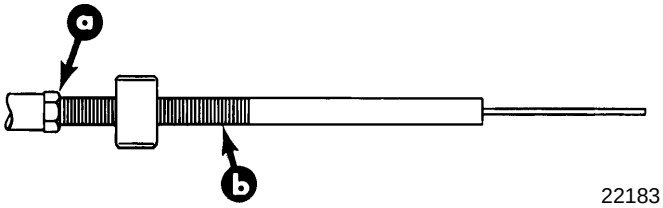
1. Remove sterndrive unit (Refer to Section 2A).
2. Disconnect shift cable from shift plate and remove end guide.



22183

a - Anchor Screws (2)
b - End Guide

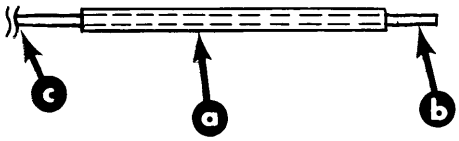
3. Remove threaded tube.



22183

a - Jam Nut
b - Threaded Tube

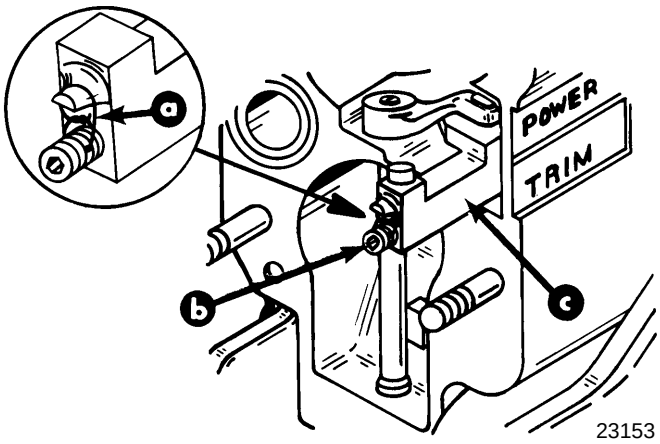
4. Cut support tube from core wire (If core wire is equipped with support tube).



22183

a - Support Tube
b - Core Wire
c - Cut Here

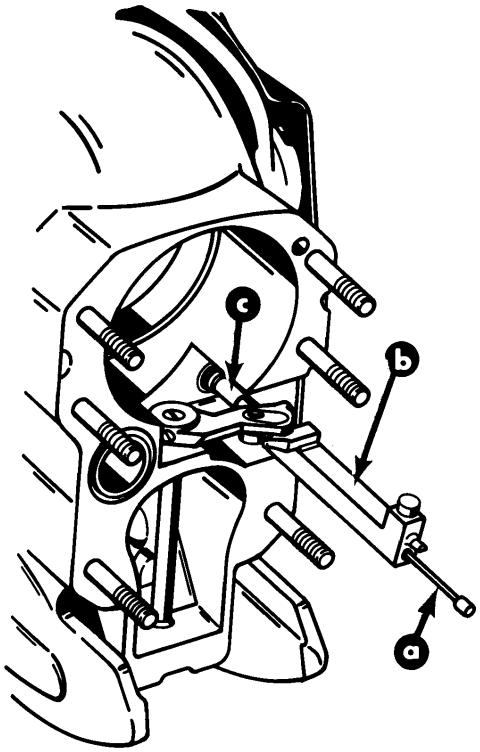
5. Remove set screw from shift slide.



23153

a - Safety Wire - Cut
b - Set Screw
c - Shift Slide

6. Remove inner core wire and shift slide.

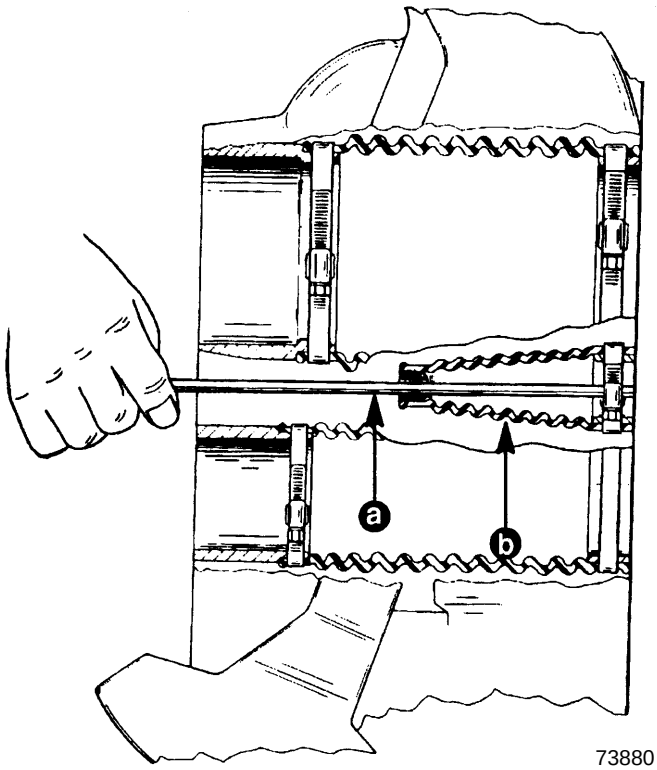


23262

a - Inner Core Wire
b - Shift Slide
c - Shift Cable

7. Remove and discard shift cable bellows crimp clamp.

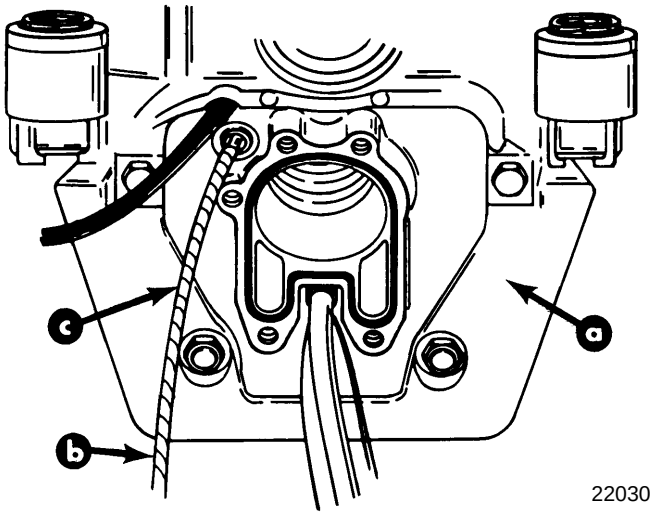
NOTE: *On units with old style shift cable, pull bellows away from bell housing after crimp clamp is removed.*



73880

a - Shift Cable
b - Shift Cable Bellows

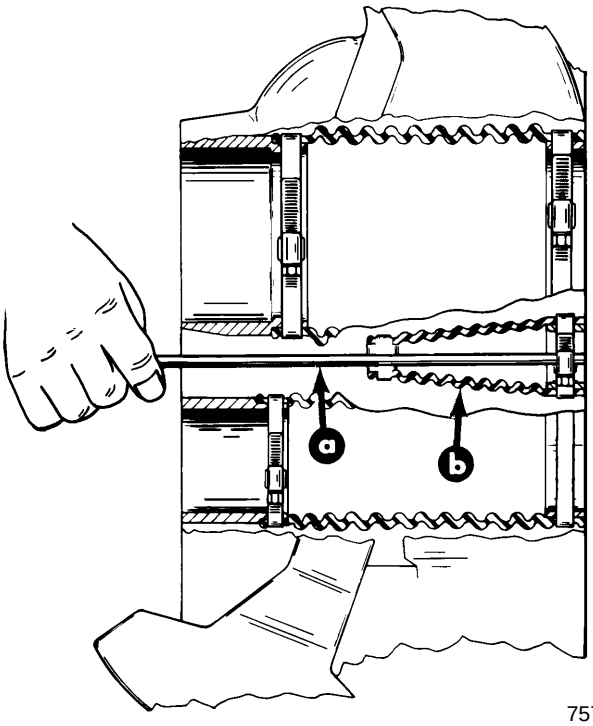
8. Remove shift cable wrapping from shift cable on inner transom.



22030

a - Inner Transom
b - Shift Cable
c - Wrapping

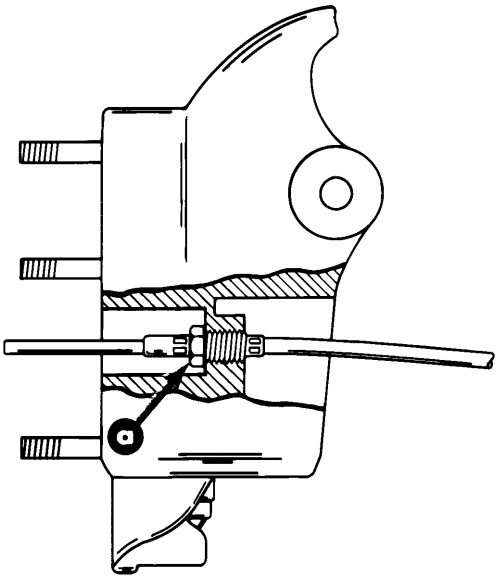
9. Pull shift cable through shift cable bellows.



75793

a - Shift Cable
b - Shift Cable Bellows

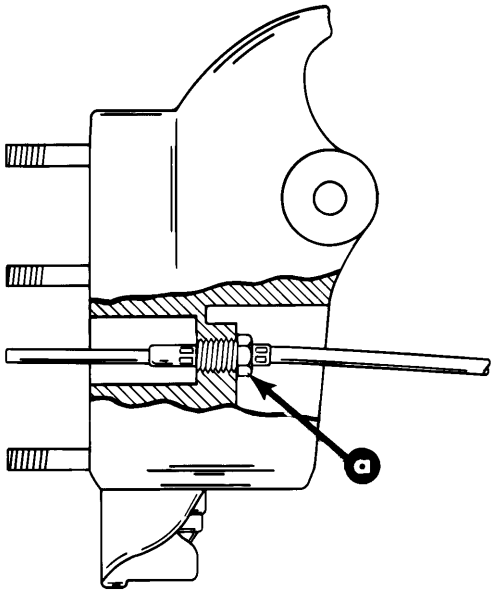
10. Using shift cable removal and installation tool (91-12037), completely loosen shift cable retaining nut.



23156

New Style Shift Cable

a - Shift Cable Retaining Nut



23169

Old Style Shift Cable

a - Shift Cable Retaining Nut

11. Pull shift cable from bell housing.

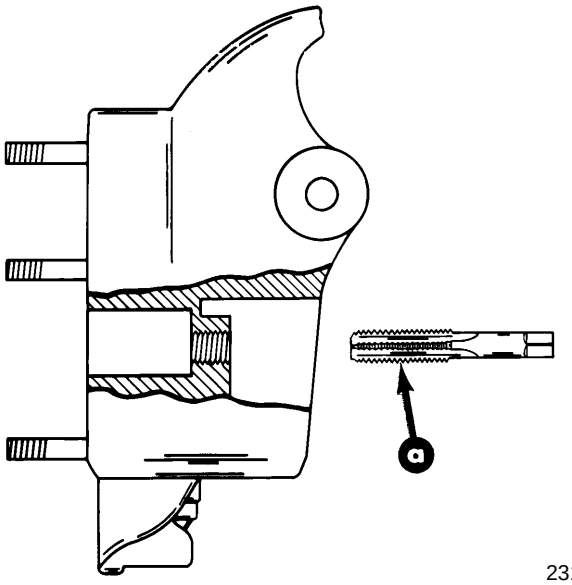
INSPECTION

1. Inspect shift cable for cuts, kinks and chafing.
2. Inspect core wire for kinks and unraveling.
3. Inspect shift cable retainer nut threads for damage.
4. Inspect for signs of retainer nut separating from outer casing.

INSTALLATION

IMPORTANT: This shift cable (which attaches to bell housing from aft end) can be used on models with old style shift cable (attached on front side of bell housing). To do this, the threaded hole in bell housing must be tapped all the way through, using a 1/4-18 NPSF tap. This special STRAIGHT THREAD TAP may be obtained through Quicksilver by ordering 91-95639. The following important information must be observed when performing tapping operation.

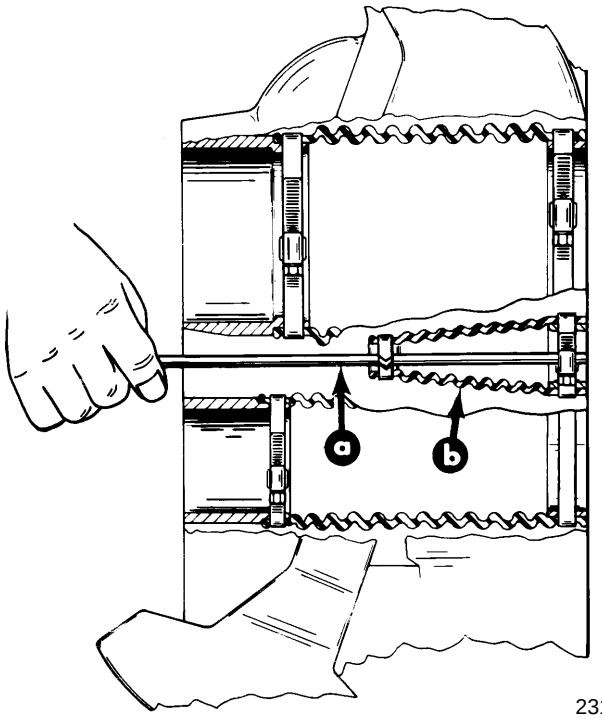
- **Tapping must be done from the front (bellows side) end of bell housing to prevent cross-threading.**
- **Never use a TAPERED THREAD TAP as improper positioning of shift cable may result, or water may leak into bell housing.**



23156

a - 1/4-18 NPSF Tap

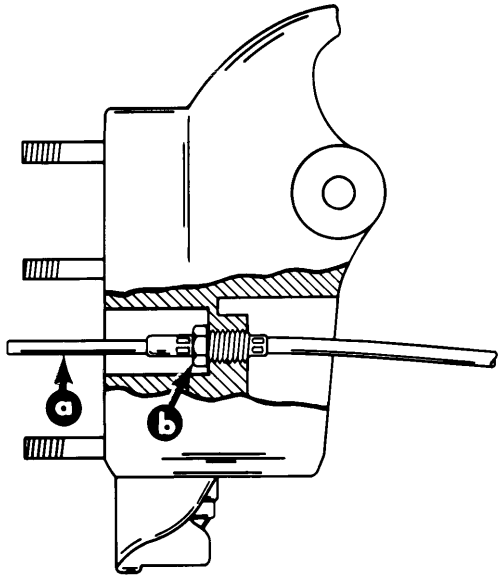
1. Insert shift cable through bell housing and shift cable bellows.



23155

a - Shift Cable
b - Shift Cable Bellows

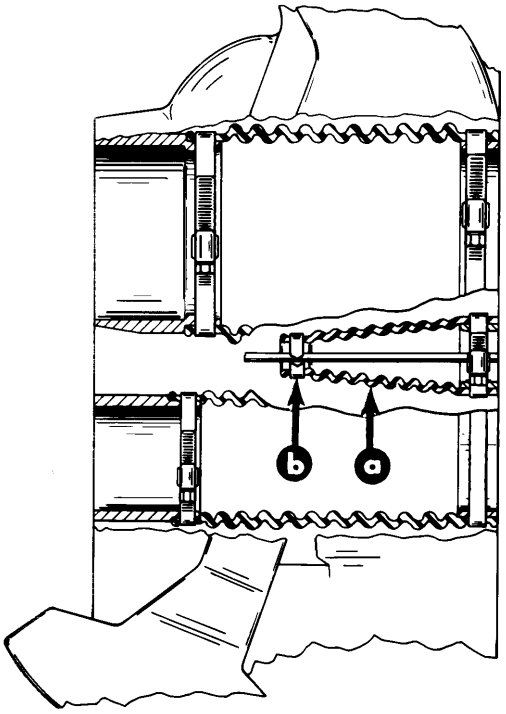
2. Apply Perfect Seal to shift cable retainer nut threads and secure shift cable to bell housing, using shift cable removal and installation tool (91-12037). No more than 2 threads on retainer nut should be exposed.



23156

a - Shift Cable
b - Retainer Nut

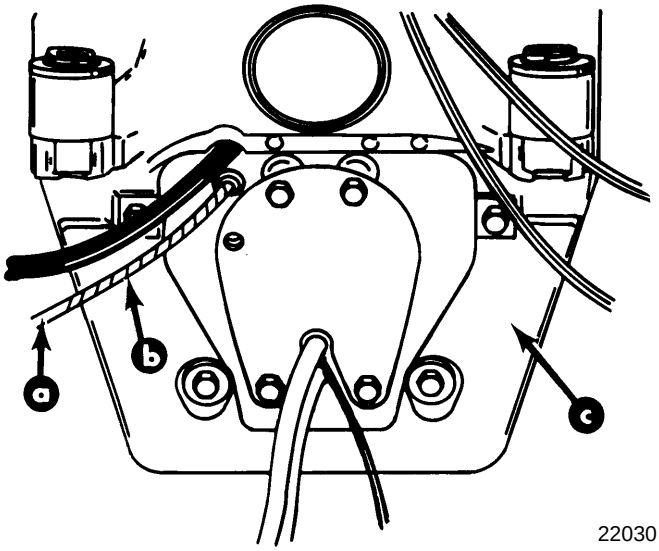
3. Install and compress shift cable bellows crimp clamp. Be sure that clamp is crimped evenly so that a good seal is maintained between bellows and shift cable. DO NOT allow bellows to flatten.



23154

a - Shift Cable Bellows
b - Crimp Clamp

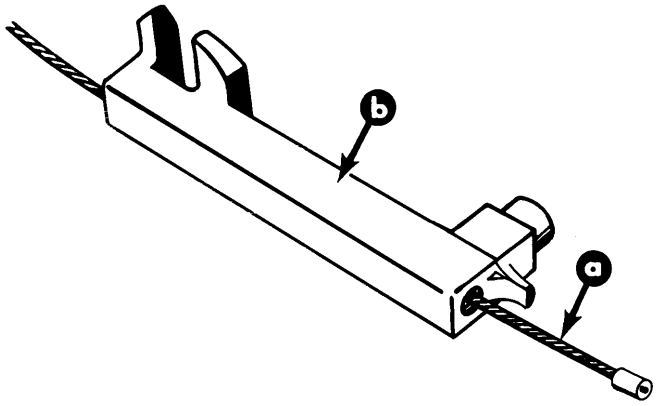
4. Install shift cable wrapping.



22030

a - Shift Cable
b - Shift Cable Wrapping
c - Inner Transom Plate

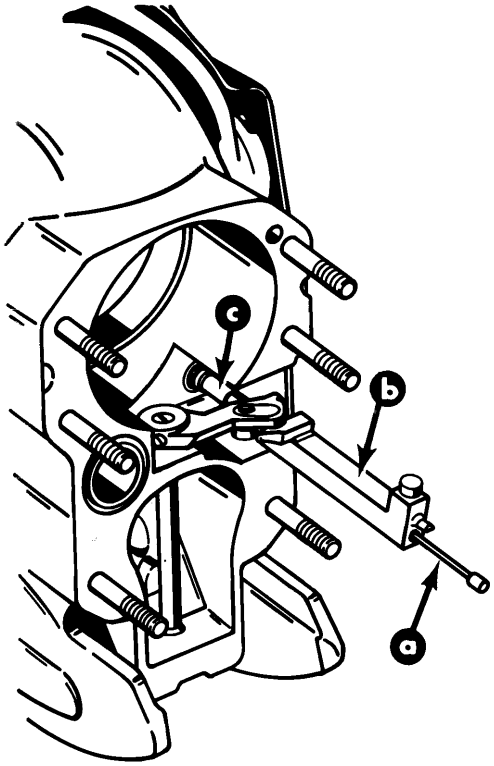
5. Install core wire through shift slide.



23262

a - Core Wire
b - Shift Slide

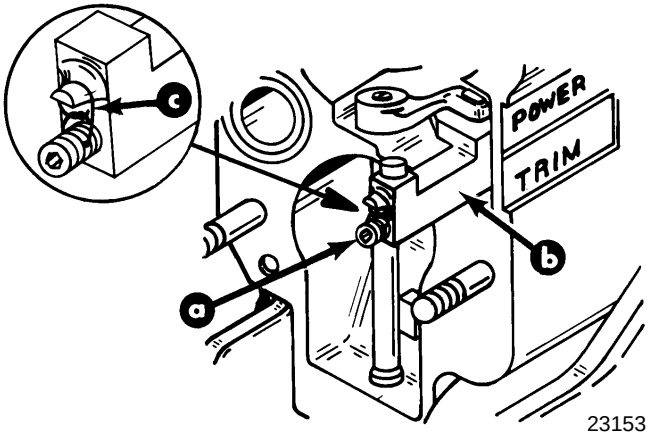
6. Install core wire through shift cable.



23262

a - Core Wire
b - Shift Slide
c - Shift Cable

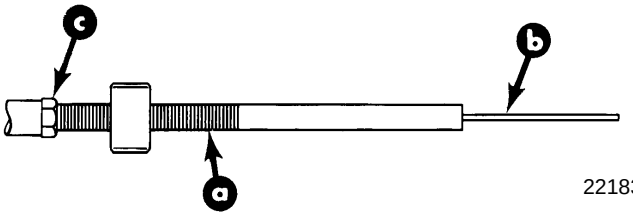
7. Install set screw into shift slide. Tighten until contact with core wire. Then back off 1/8 turn max. Safety wire set screw to shift slide using a “figure 8” pattern. Twist until tight and cut off excess length of safety wire.



23153

a - Set Screw
b - Shift Slide
c - Safety Wire

8. Install thread tube on shift cable and tighten until it just bottoms. Secure jam nut against shift cable end.

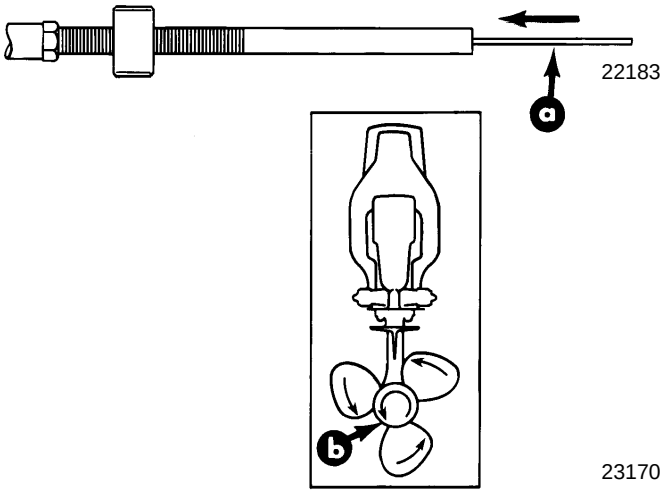


22183

a - Threaded Tube
b - Core Wire
c - Jam Nut

9. Install sterndrive unit (Refer to Section 2A).

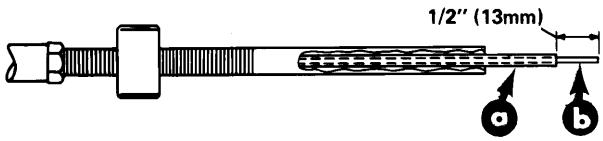
10. Shift drive unit into forward gear by pushing in on core wire with a pair of pliers, while rotating propeller shaft counterclockwise. Ensure clutch is fully engaged.



22183
23170

a - Core Wire
b - Propeller Shaft

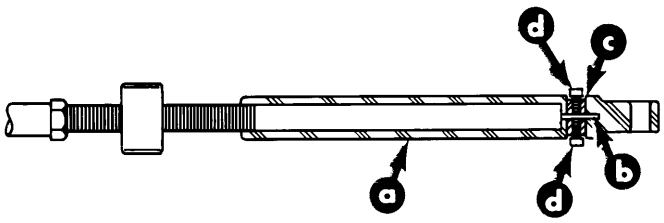
11. **(If using older style core wire equipped with support tube)** Position support tube so that 1/2 in. (13 mm) of core wire extends from edge of support tube. Crimp end of support tube.



22183

a - Support Tube
b - Core Wire

12. Install shift cable end guide over core wire and insert core wire through cable anchor. Tighten screws securely.

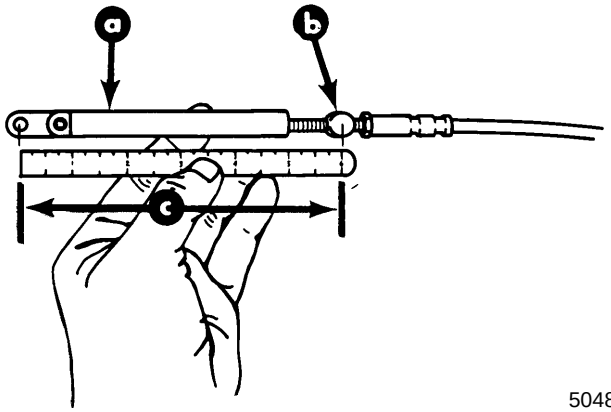


22183

a - Shift Cable End Guide
b - Core Wire
c - Cable Anchor
d - Screws (2)

13. Push in on drive unit shift cable while simultaneously turning propeller shaft counterclockwise until shaft stops, to ensure drive unit is completely in forward gear. Maintain pressure on propeller shaft with a suitable device (elastic strap).

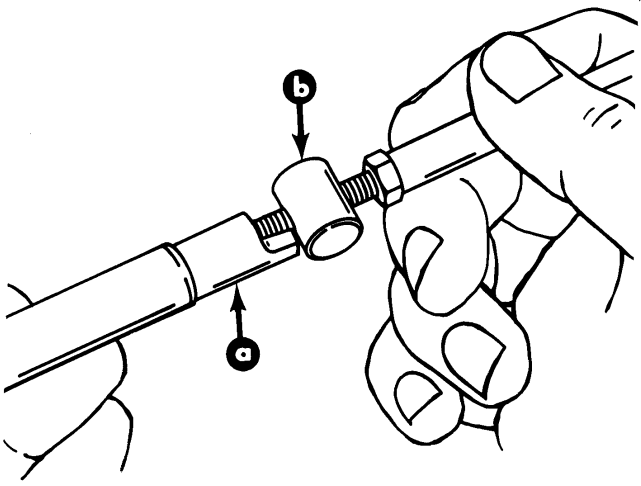
14. Measure distance between center of hole in shift cable end guide and center of brass barrel. Measurement should be 6 in. (153 mm).



50484

a - End Guide
b - Brass Barrel
c - 6 in. (153 mm)

15. If old shift cable was equipped with an end guide stop clip, remove clip from old shift cable. Once brass barrel adjustment is correct, install end guide stop clip on threaded tube. Position as shown, with tang touching brass barrel.



50484

a - Stop Clip
b - Brass Barrel

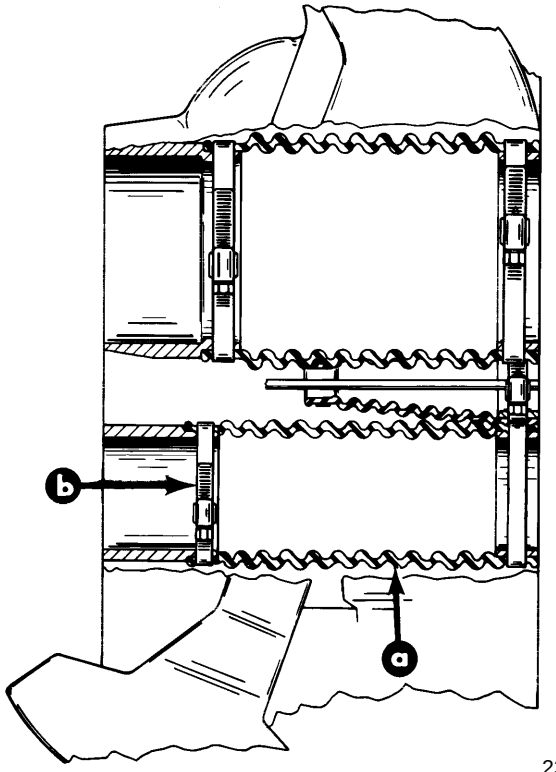
16. Adjust shift cable. (Refer to Section 2A).

Exhaust Bellows

REMOVAL

1. Remove sterndrive unit (Refer to Section 2A).

2. Loosen hose clamps and remove exhaust bellows.



23158

a - Exhaust Bellows
b - Hose Clamp

CLEANING AND INSPECTION

1. Inspect exhaust bellows for internal charring, cracks, cuts or hardening.

2. Clean old adhesive from bellows mounting flange on gimbal housing and on bell housing using lacquer thinner.

3. Clean old adhesive from mounting surfaces of exhaust bellows if reusing old bellows.

4. Roughen exhaust bellows mating surfaces with sandpaper and wipe clean with lacquer thinner.

INSTALLATION

⚠WARNING

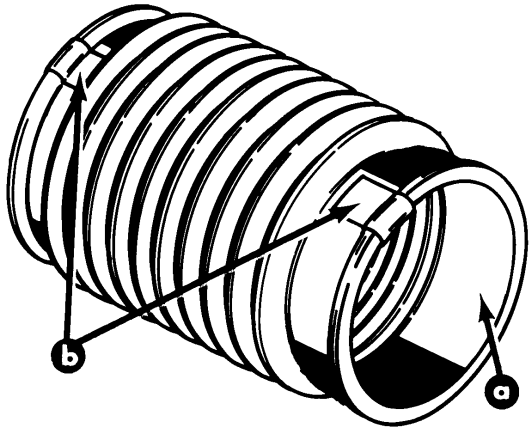
Bellows adhesive contains toluol and petroleum distillates which are harmful or fatal if swallowed. Avoid prolonged contact with skin or breathing of vapors. If swallowed, do not induce vomiting. Call physician immediately. Keep out of reach of children.

1. Apply bellows adhesive to mounting surfaces on inside of bellows. Allow to dry until no longer tacky (approximately 10 minutes).

⚠CAUTION

Bellows clamps may corrode if grounding clips are not installed.

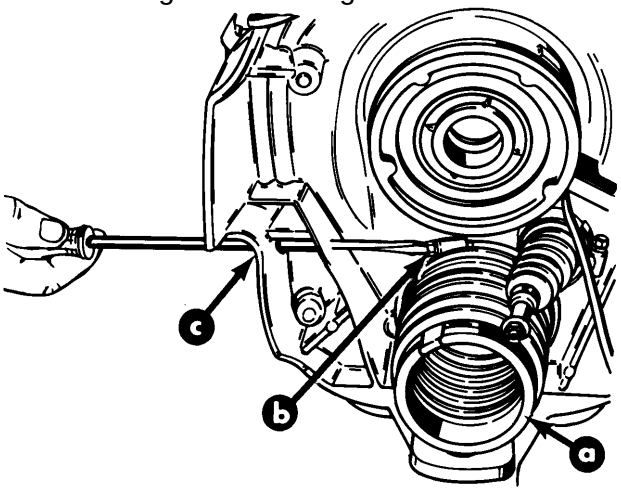
2. Position grounding clips on bellows.



22079

a - Mounting Surface (Apply Bellows Adhesive)
b - Grounding Clips

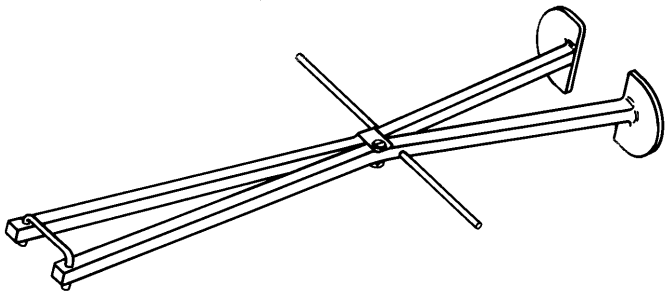
3. Install exhaust bellows onto gimbal housing. Position hose clamp as shown. Tighten hose clamp screw using a screw driver through access holes in gimbal housing.



22081

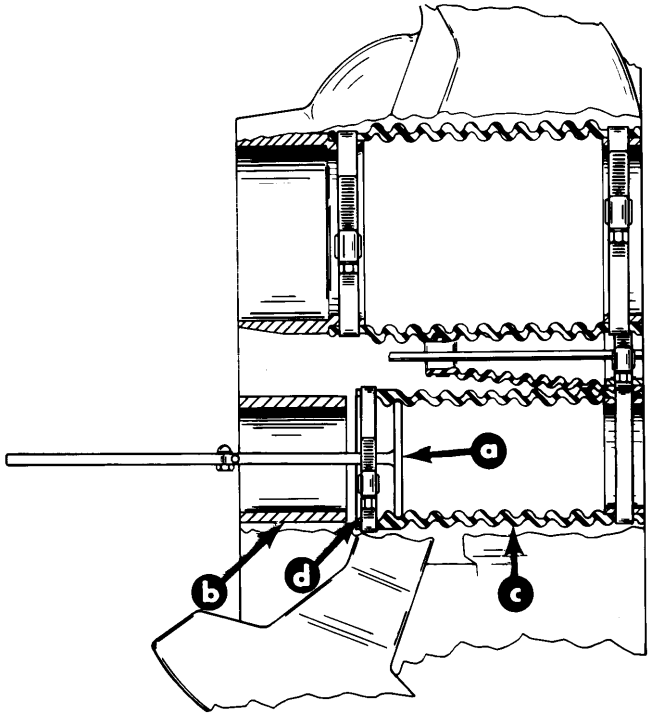
a - Exhaust Bellows
b - Hose Clamp
c - Gimbal Housing Access Hole

4. Install exhaust bellows on bell housing as follows:
   a. Place a hose clamp over bellows end.
   b. Place expander tool into first bellows convolution.



22161

   c. Pull tool until tool touches the flange on bell housing (hose starts to slip onto flange); then release tool.



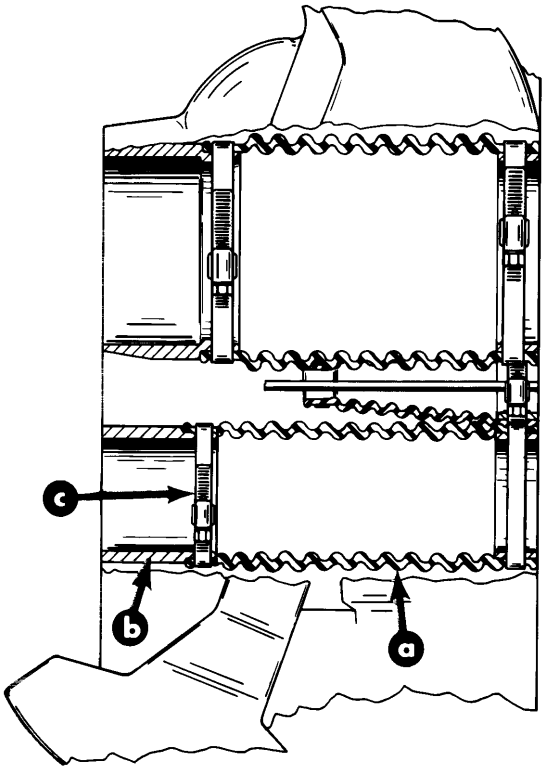
23154

a - Expander Tool (91-45497A1)
b - Bell Housing Flange
c - Exhaust Bellows
d - Hose Clamp

d. Reposition tool into third bellows convolution.

e. Pull bellows onto bell housing flange.

f. Tighten hose clamp.



23158

a - Exhaust Bellows
b - Bell Housing Flange
c - Hose Clamp

Exhaust Tube (If Equipped)

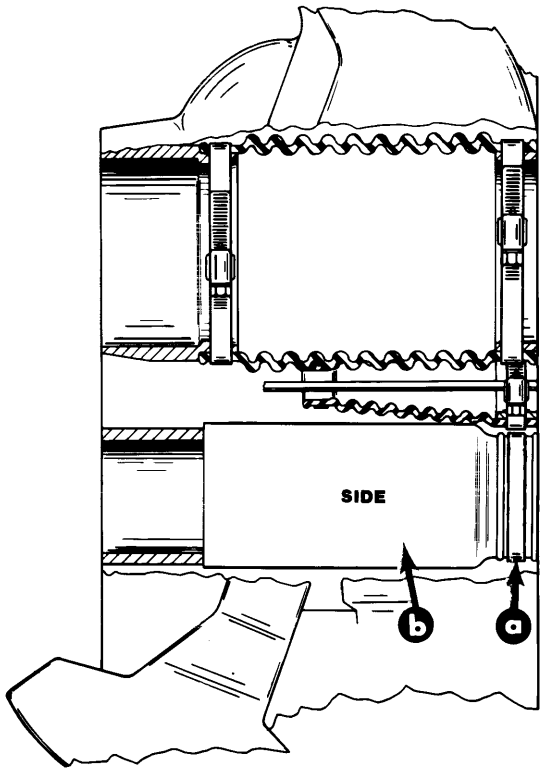
REMOVAL

NOTE: *It is not necessary to remove drive unit when replacing exhaust tube.*

⚠CAUTION

Support aft end of drive unit as an added safety measure when working between bell housing and gimbal housing.

1. Raise drive unit to the full UP/OUT position.
2. Loosen hose clamp and remove exhaust tube.



23158

a - Hose Clamp
b - Exhaust Tube

CLEANING AND INSPECTION

1. Inspect exhaust tube for charring, cracks, cuts and hardening.
2. Roughen exhaust tube mating surfaces with sandpaper and wipe clean with lacquer thinner.

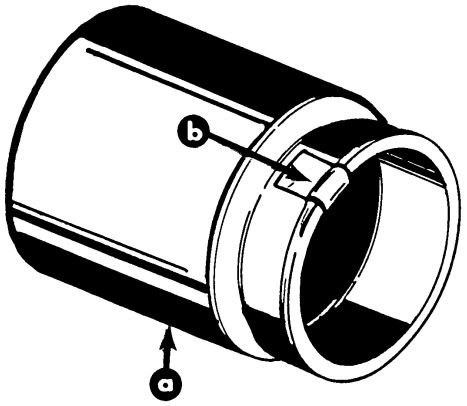
INSTALLATION

NOTE: *Bellows adhesive is not used when installing an exhaust tube.*

⚠ CAUTION

Exhaust tube hose clamp may corrode if grounding clip is not installed.

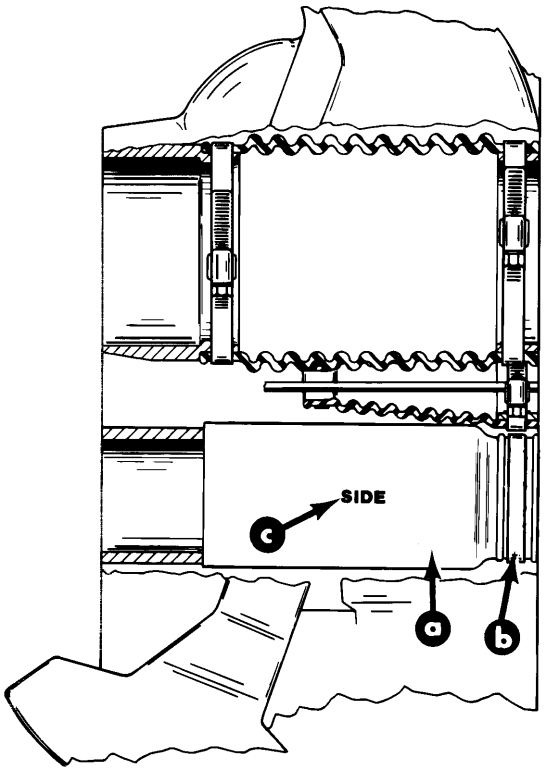
1. Position grounding clip on exhaust tube as shown.



22184

a - Exhaust Tube
b - Grounding Clip

2. Install exhaust tube on gimbal housing as follows:
   a. Position tube so that “SIDE” markings on tube are facing to the right and left sides (NOT UP and DOWN).
   b. Position hose clamp so that screw will align with screw driver access hole in port (left) side of gimbal housing.
   c. Tighten hose clamp.



23158

a - Exhaust Tube
b - Hose Clamp
c - “SIDE” Marking

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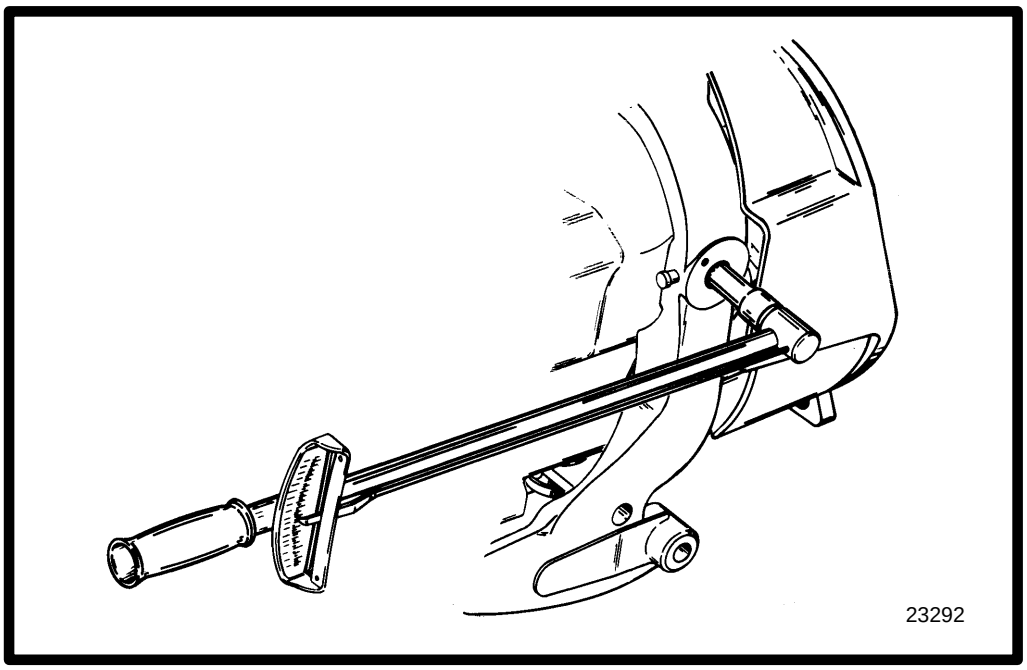
TRANSOM ASSEMBLY

4

B



SERVICE PROCEDURES REQUIRING MAJOR DISASSEMBLY

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Specifications

Torque Specifications

Fastener Location	Torque
Hinge Pins - Gimbal Ring to Bell Housing	105 - 115 lb. ft. (141 - 155 N·m)
Screws - Gimbal Ring	50 - 55 lb. ft. (67 - 74 N·m)
Screw and Nut - Steering Lever	75 lb. ft. (101 N·m)
Screws, Nut - Transom Assembly Attaching	20 - 25 lb. ft. (27 - 34 N·m)

Lubricants/Sealers/ Adhesives

Description	Part No.
2-4-C Marine Lubricant	92-825407A2
Perfect Seal	92-34227-1
Anti-Corrosion Grease	92-78376A6
3M Brand Bellows Adhesive	92-86166-1
Locquic Primer “T”	92-59327-1
Loctite RC 680	92-809833
Special Lubricant 101	92-13872A1
Loctite 27131	92-809820

Special Tools

Tool Description	Part Number
Driver	91-33492
Driver	91-33491
Driver	91-33489
Driver Head	91-32325
Driver Rod	91-37323
Drive Shaft Nut Wrench	91-56775
Engine Alignment Shaft	91-805475A1
Expander Tool	91-45497A1
Hinge Pin Tool	91-78310
Mandrel	91-30366-1
Nut	11-24156
Plate (2)	91-29310
Puller	91-63616
Puller Head	91-38919
Puller Shaft	91-31229
Slide Hammer Puller	91-34569A1
Washer	12-34961
Bushing Installation Tool	91-805057A2

Special Information

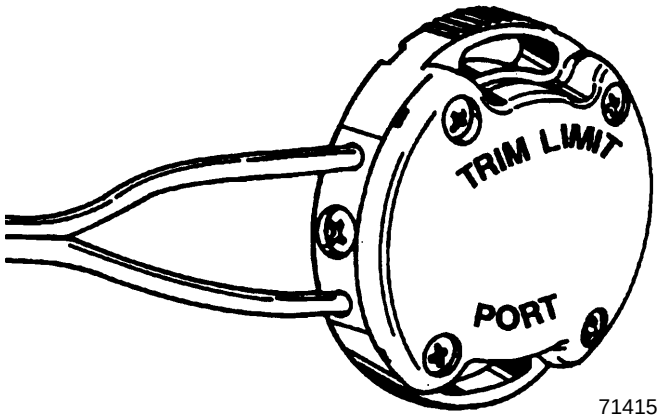
Trim Limit Switch

Transom assembly serial number 6271054 and above.

The newer style trim limit switch has a new sealing system for improved water resistance and durability. The trim limit switch leads are connected internally on the newer style switch to help ensure good electrical integrity.

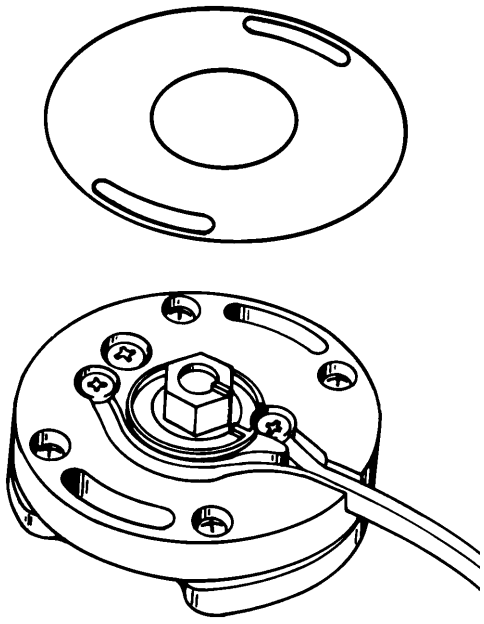
NOTE: *Insulator used with older style switch is not required when using newer style switch.*

The newer style trim limit switch is used as a replacement part for all MerCruiser I-MR and Alpha One models. Trim limit switch leads are provided with the newer switch and are pre-connected at the factory.



71415

Newer Style Trim Limit Switch



22160

Older Style Trim Limit Switch

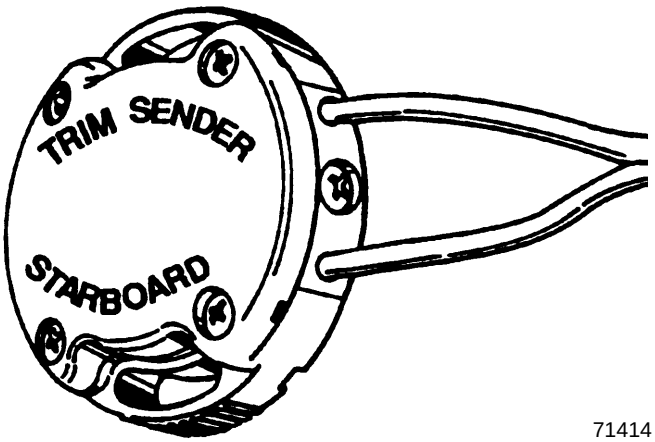
New Trim Position Sender

Transom assembly serial number OC566037 and above.

The newer style trim position sender has a new sealing system for improved water resistance and durability. The sender leads are connected internally on the newer style sender to help ensure good electrical integrity.

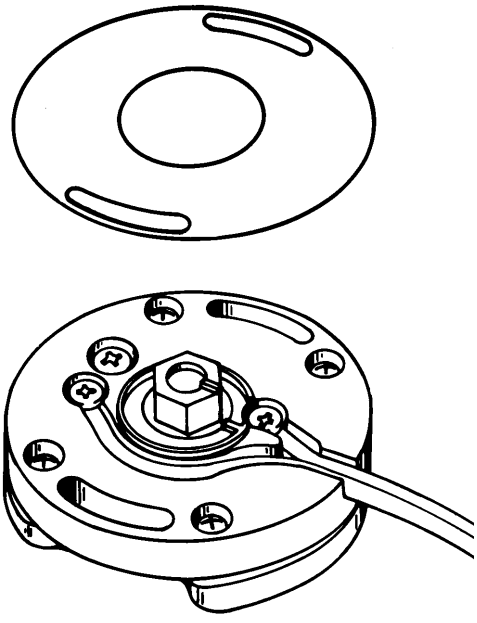
NOTE: *Insulator used on older style sender is not required when using newer style sender.*

The newer style trim position sender is used as a replacement part for all MerCruiser I-MR and Alpha One models. Trim position sender leads are provided with the newer sender and are pre-connected at the factory.



71414

New Style Trim Position Sender



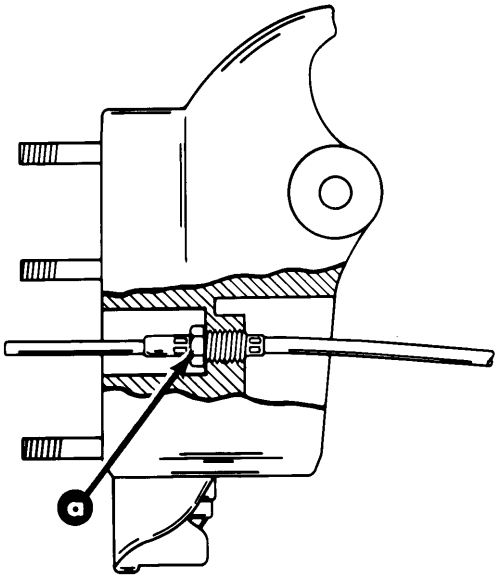
22160

Older Style Trim Position Sender

Shift Cable

Transom assembly serial number 6376504 and above.

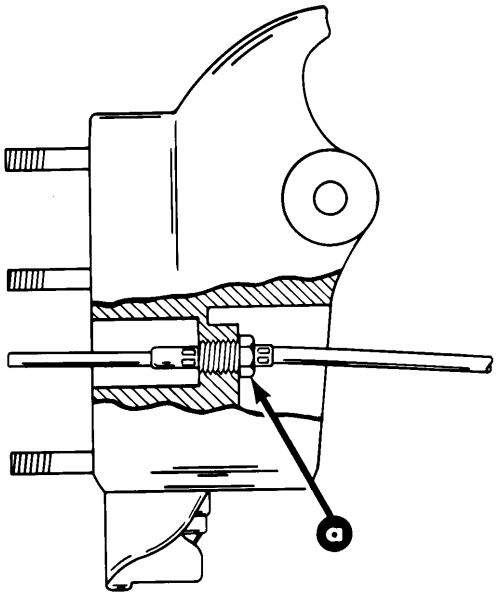
A new style drive unit shift cable attaches to the bell housing from the aft end (rather than the front end as did the old style cable) for easier removal and installation. With the exception of the cable attaching method, the installation and adjustment procedure is the same as the old style cable. A Drive Unit Shift Cable Removal and Installation Tool 91-12037 is required for cable removal and installation.



23156

New Style Shift Cable

a - Shift Cable Retaining Nut



23169

Old Style Shift Cable

a - Shift Cable Retaining Nut

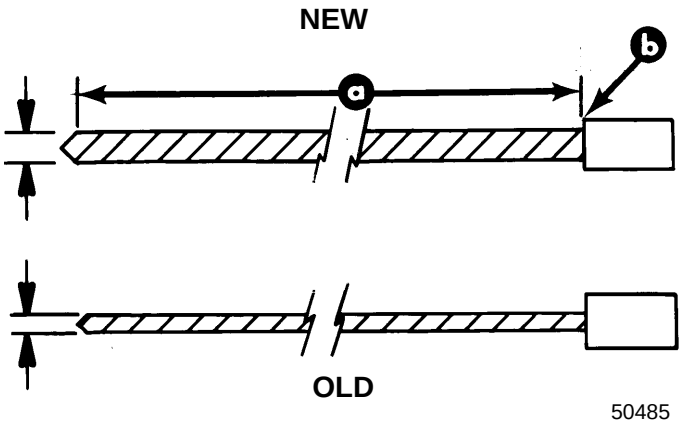
The new style cable can be used on all MerCruiser models.

Transom assembly serial number 0C698141 and above.

A new style drive unit shift cable is being used. Following is a list of the major differences from the earlier cable.

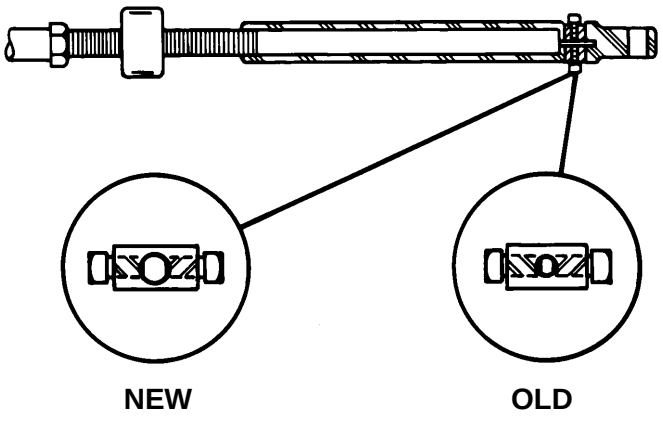
IMPORTANT: The new style shift cable will be pre-cut to proper length and should be replaced as an assembly only. DO NOT mix parts between old and new style.

1. Larger Diameter Armor Wrapped Core Wire.
2. Larger Diameter Hole in Shift Cable Anchor.
3. Larger Diameter Hole Inside of Shift Slide.
4. Larger Diameter Shift Cable Conduit (To Accommodate Larger Diameter Core Wire).

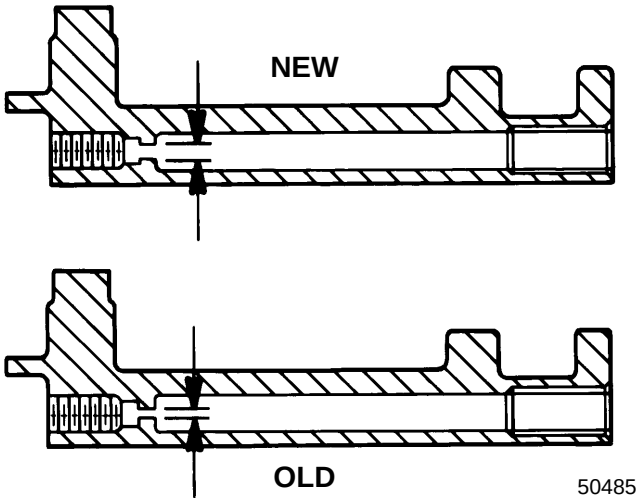


Core Wires

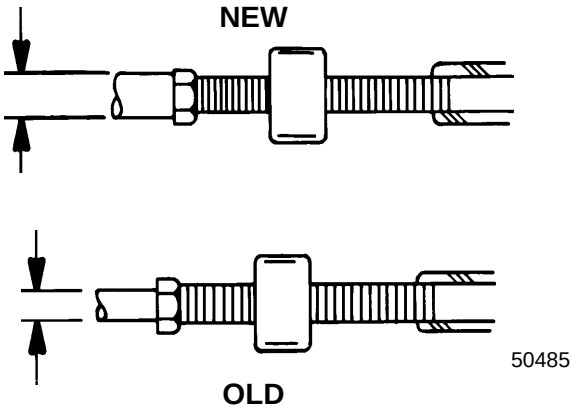
a - New Pre-Cut Core Wire Dimension 72-1/8 in. (1832 mm)
b - Front Edge of Anchor



Cable Anchors



Shift Slides



Shift Cable Conduit

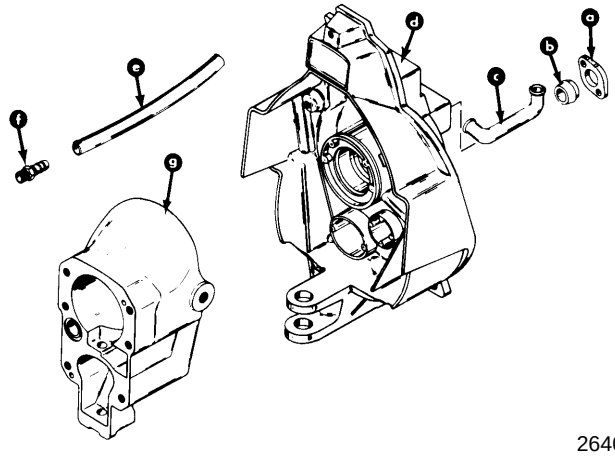
Gimbal Housing Water Tube

Transom assembly serial number 6665169 and above will be equipped with a 3/4 in. (19 mm) I.D. gimbal housing water tube and hose for increased cooling capacity. Older sterndrives were fitted with a 5/8 in. (16 mm) water tube and hose. New tube and hose can not be used on older sterndrives.

The following transom assembly components also were changed to accommodate the new tube and hose.

- Bell Housing
- Bell Housing Hose Fitting
- Gimbal Housing
- Water Tube Bushing
- Water Tube Cover

To further increase water flow, the cross-drilled water passage in the drive unit drive shaft housing was enlarged.



26408

New Gimbal Housing Water Tube, Hose and Related Parts

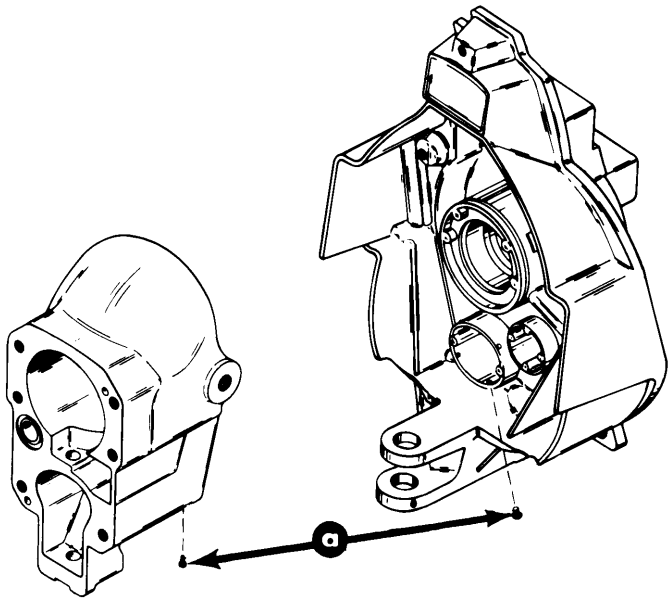
a - Cover
b - Bushing
c - Tube
d - Gimbal Housing
e - Water Hose
f - Hose Fitting
g - Bell Housing

Replacement Bell Housing

A new MerCruiser bell housing is being used as the replacement part for all MerCruiser I models with trim limit switch on the side of the gimbal ring. Bell housing is shipped with hose fitting for a 3/4 in. I.D. hose preinstalled. When using this bell housing on an older model (with 5/8 in. I.D. hose), it will be necessary to remove the 3/4 in. fitting and install the special 5/8 in. fitting provided.

Drive Screws Removal

To improve corrosion resistance, the drive screws have been removed from the gimbal housing and bell housing on MerCruiser IR/IMR/Alpha One.



26408

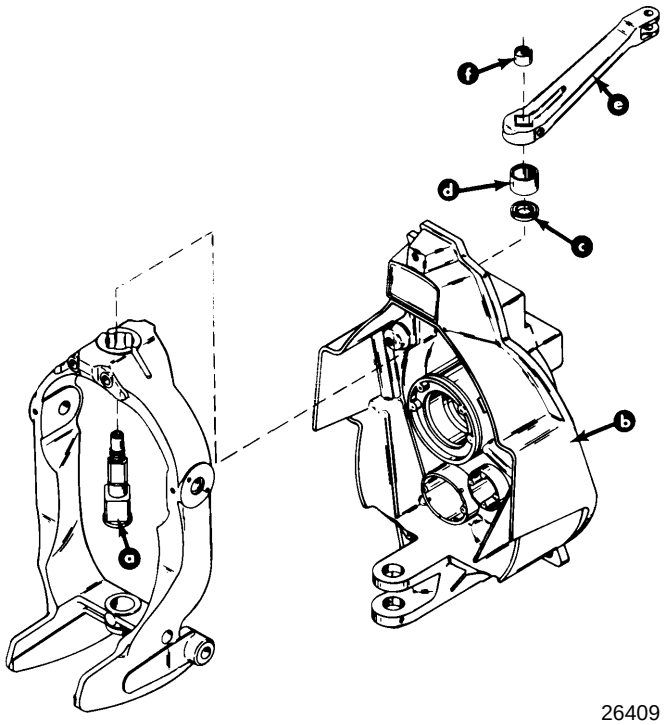
Bell Housing and Gimbal Housing Drive Screws

a - Drive Screws (8)

Upper Swivel Shaft

Transom assembly serial number 6666130 and above.

A new square swivel shaft steering lever provides a square connection at both the steering lever and gimbal ring for improved durability. In the past, a splined connection was used between the steering lever and swivel shaft. To facilitate this change, a new swivel shaft seal and two (2) new bushings were required. The gimbal housing also is machined differently. The new swivel shaft and steering lever components can not be used on older models.



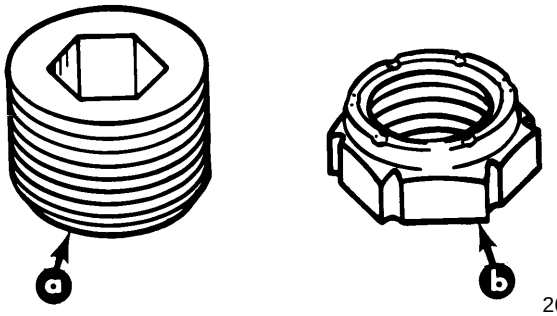
26409

Square-Square Swivel Shaft, Steering Lever and Related Components

a - Square - Square Swivel Shaft
b - Gimbal Housing
c - Seal
d - Bushing
e - Steering Lever
f - Bushing

Gimbal Housing Access Plug Kit

This kit, available for use on MerCruiser Transom assemblies, allows for removal and installation of gimbal ring without having to remove engine and transom assembly. A template also is included in this kit to locate access holes.



26409

a - Plastic Plugs (2)
b - Nut Swivel Shaft Nut

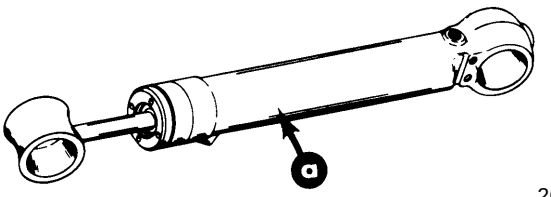
Increased Drive Unit Trim Range

MerCruiser I-MR and Alpha One models will have an additional 3° trim “IN” capability. This should help to get the boat bow down, thereby improving acceleration on some boats.

The additional trim capability was accomplished by the use of new trim cylinders and the gimbal ring.

New trim cylinders can be distinguished from the old ones by observing the casting number on the outer tube.

	Present	Later	Older
Port Trim Cylinder	14034-1	98703-1	98703
Starboard Trim Cylinder	14035-1	98704-1	98704

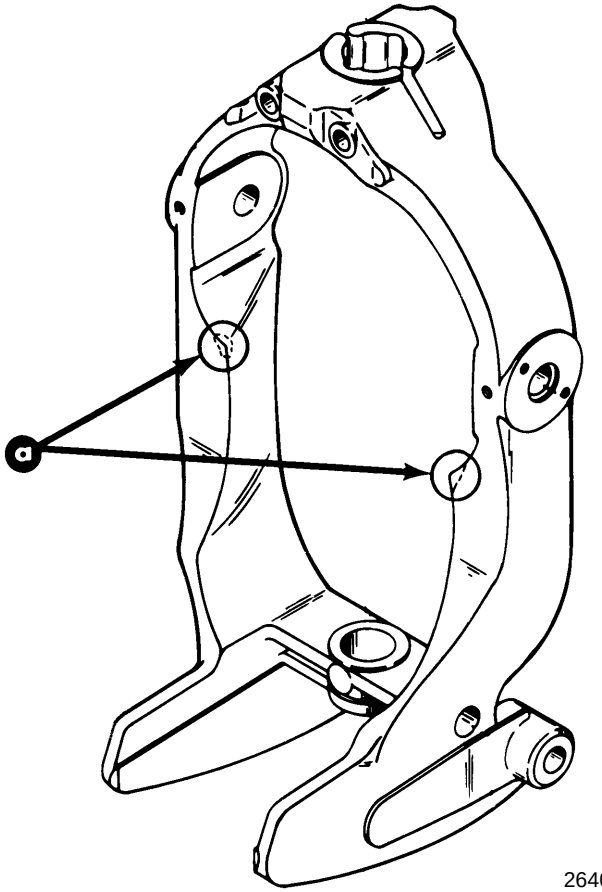


26409

Trim Cylinder Casting Location

a - Part Number Location

The new trim cylinders will be used as a service replacement for older MerCruiser 120R through 260R and MR models. A new trim cylinder can be intermixed with an old trim cylinder on the same unit. If the additional 3° of trim “IN” is desired, both new trim cylinders must be used. In some cases, it also may be necessary to remove a small amount of metal from the gimbal ring (in the area shown in Figure 1) to provide clearance between bell housing and gimbal ring when unit is in the full “IN” position.



26409

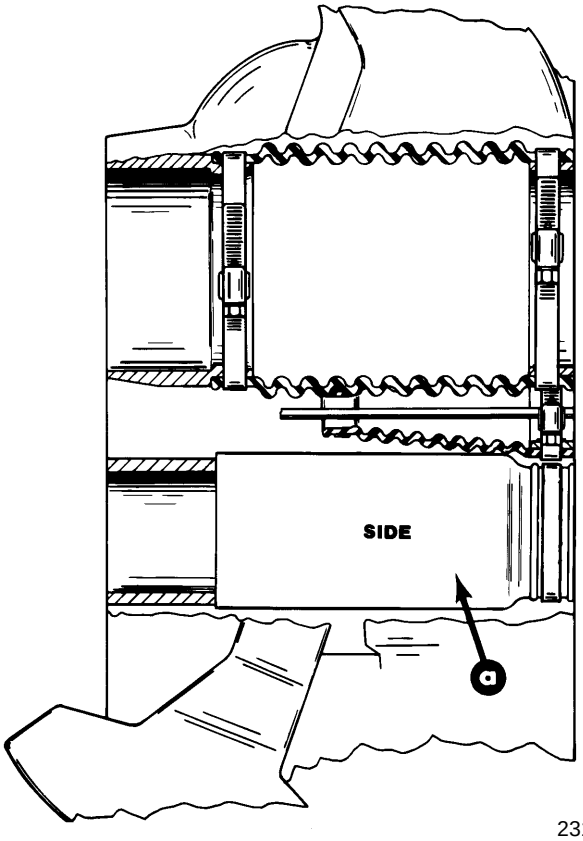
Gimbal Ring Modification

a - Remove Metal From This Area

New gimbal ring will be used as a service replacement part for all MerCruiser I models that have the trim limit switch on the side of the gimbal ring.

Exhaust Tube Use on V-8 Drive Shaft Extension Models

Early MerCruiser IR-IMR V-8 Drive Shaft Extension models were equipped with an exhaust bellows. Later V-8 drive shaft extension models utilize an exhaust tube. If servicing a unit equipped with an exhaust bellows, bellows should be replaced with a tube, as excessive exhaust gas back pressure will result if bellows are used. In addition to affecting performance, excessive pressure may cause exhaust bellows to balloon out and contact U-joint bellows, pushing them against U-joints. Eventually, the U-joint bellows may chafe through with a subsequent water leak resulting.



23158

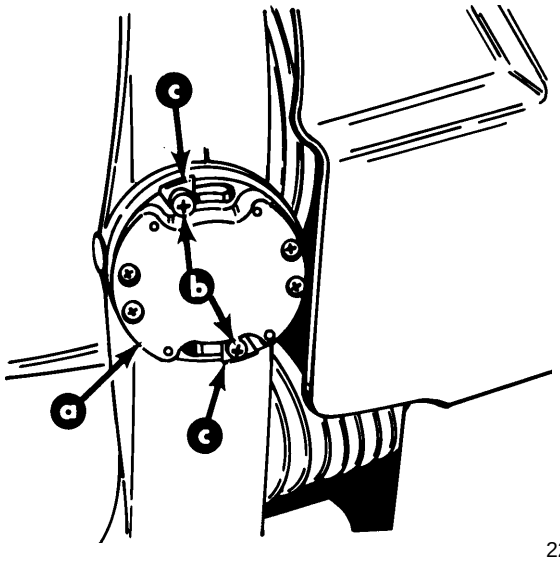
Exhaust Tube Installation

a - Exhaust Tube 78458A1

Component Disassembly

Bell Housing Removal

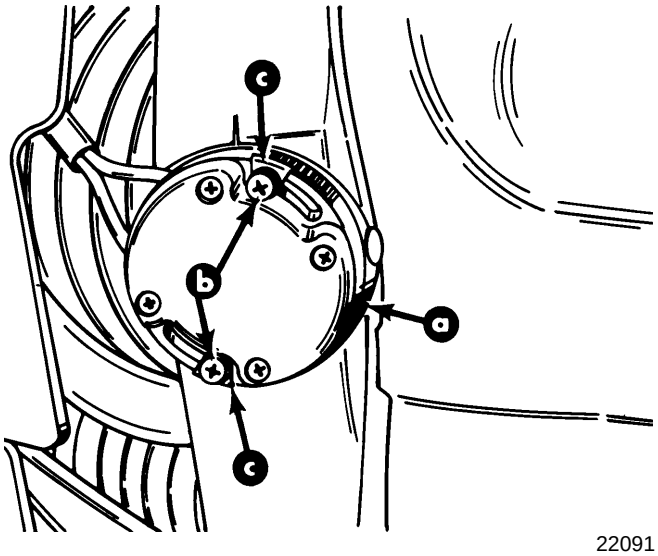
1. Remove sterndrive unit (Refer to Section 2A).
2. Remove trim position sender.



22091

a - Trim Position Sender
b - Screws (2)
c - Retainer (2)

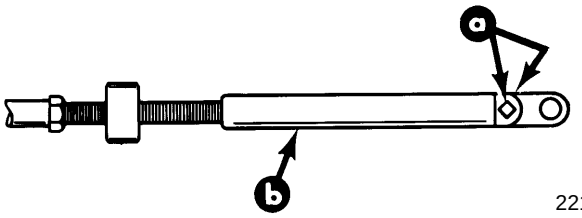
3. Remove trim limit switch.



22091

a - Trim Limit Switch
b - Screws (2)
c - Retainers (2)

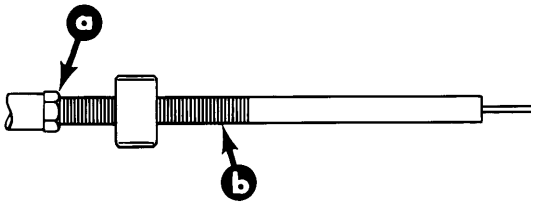
4. Disconnect shift cable from shift plate and remove cable end guide.



22183

a - Anchor Screws (2)
b - End Guide

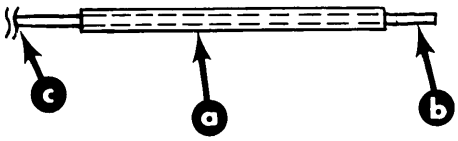
5. Remove threaded tube.



22183

a - Jam Nut
b - Threaded Tube

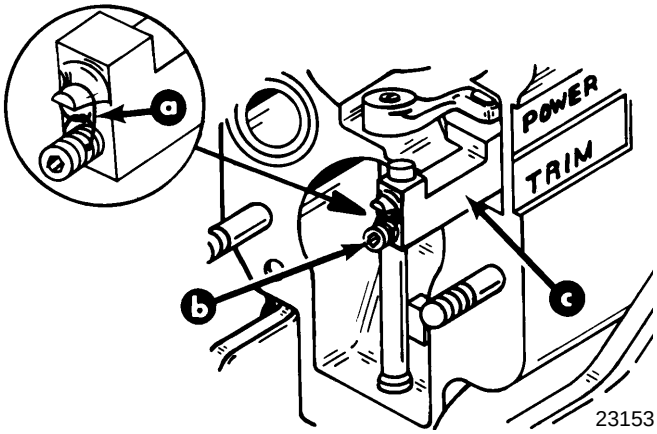
6. Remove support tube from core wire (if equipped with support tube).



22183

a - Support Tube
b - Core Wire
c - Cut Here - If Necessary

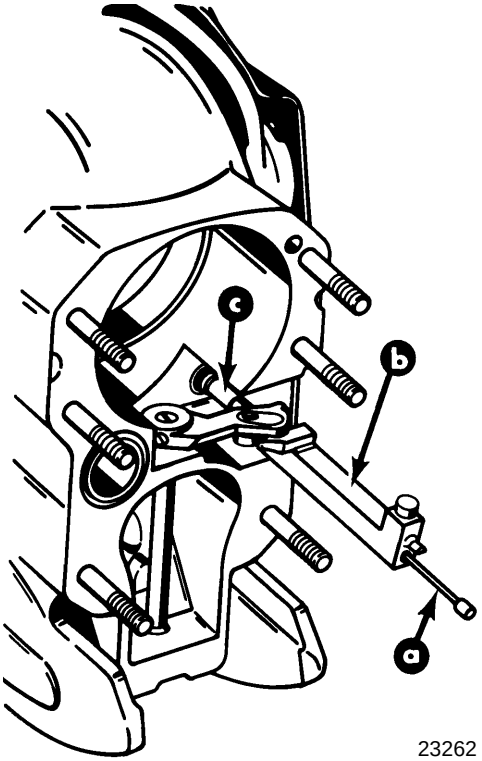
7. Remove set screw from shift slide.



23153

a - Safety Wire - Cut
b - Set Screw
c - Shift Slide

8. Remove inner core wire and shift slide.

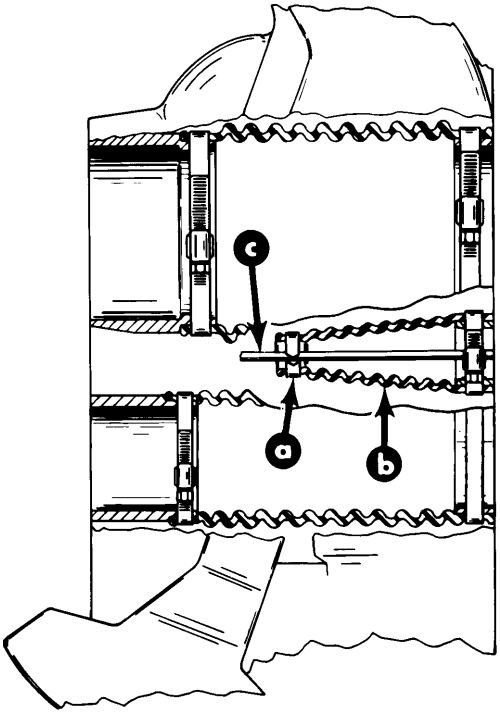


23262

a - Inner Core Wire
b - Shift Slide
c - Shift Cable

NOTE: *On units with old style shift cable, pull bellows away from bell housing after crimp clamp is loosened.*

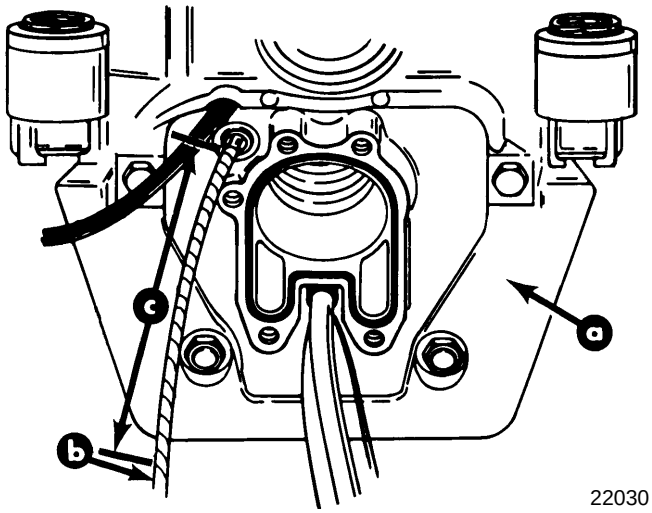
9. Remove and discard shift cable bellows crimp clamp.



23154

a - Crimp Clamp
b - Shift Cable Bellows
c - Shift Cable

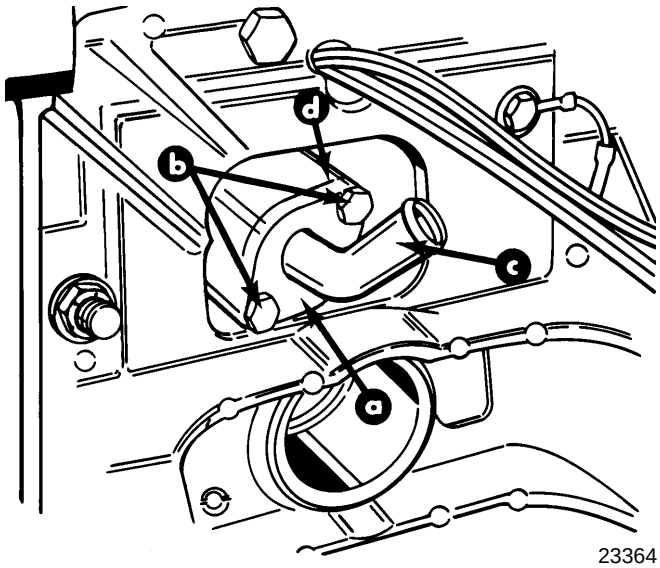
10. Remove shift cable wrapping from shift cable on inner transom.



22030

a - Inner Transom
b - Shift Cable
c - Wrapping

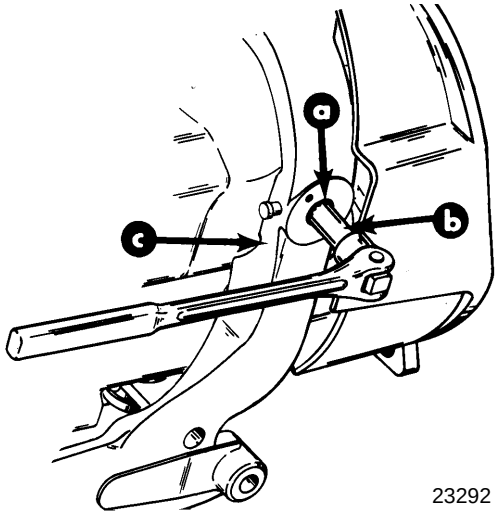
11. Remove water tube cover and rubber grommet. Push water tube through gimbal housing.



23364

a - Water Tube Cover
b - Screws
c - Water Tube
d - Rubber Grommet (Beneath Cover)

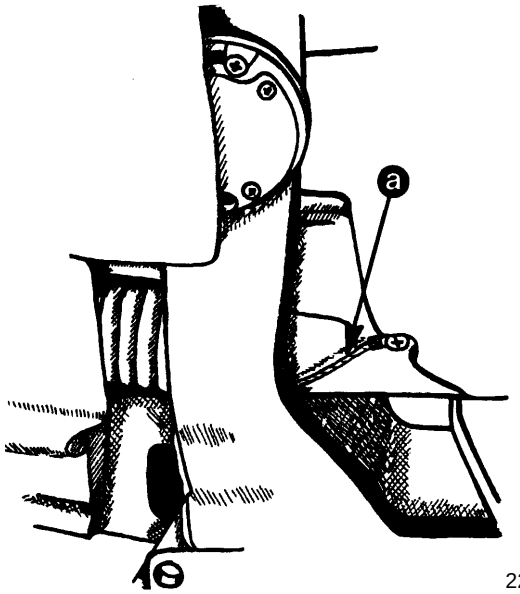
12. Remove hinge pins. Apply heat to bell housing, if necessary, to soften Loctite.



23292

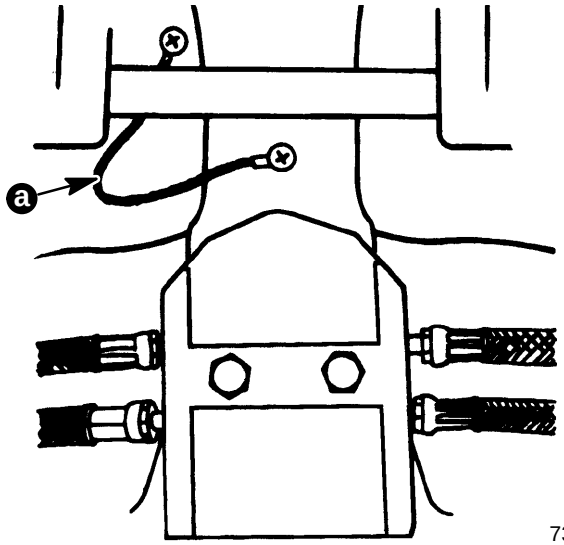
a - Hinge Pins
b - Hinge Pin Tool
c - Apply Heat Here

13. Remove bell housing as follows:
    a. Disconnect port side continuity wire from bell housing.



22755

a - Port Side Continuity Wire



73892

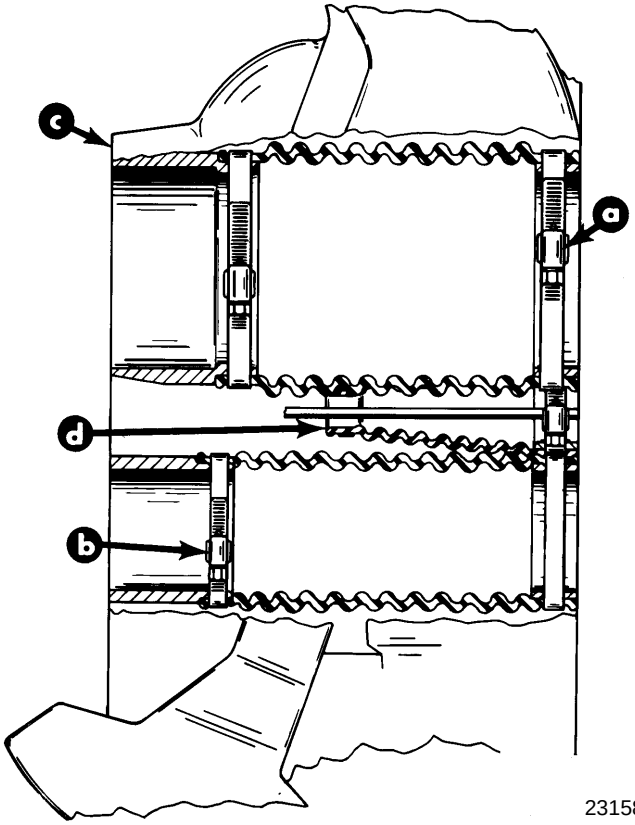
a - Continuity Wire

b. Loosen U-joint bellows front hose clamp.

c. Loosen exhaust bellows rear hose clamp.

d. Pull bell housing away from gimbal housing.

e. Pull shift cable through shift cable bellows.



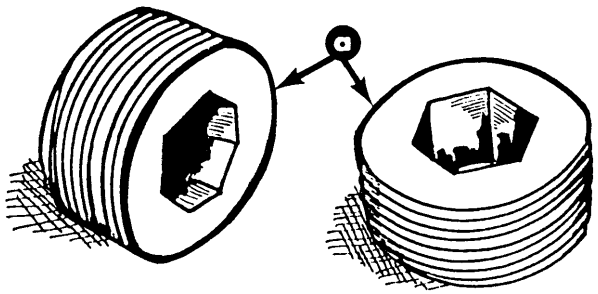
23158

a - U-joint Bellows Front Hose Clamp
b - Exhaust Bellows Rear Hose Clamp
c - Bell Housing
d - Shift Cable Bellows

Access Plug Kit Installation

NOTE: *If steering lever cavity is not accessible, it will be necessary to drill access holes in the gimbal housing. This procedure requires the following:*

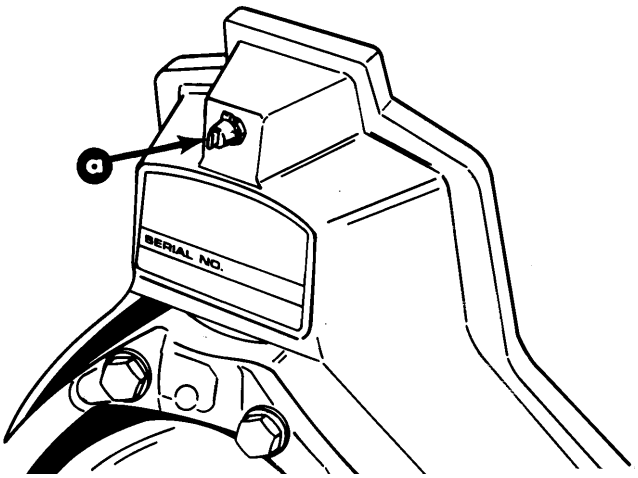
Access Plug Kit 22-88847A1
1-1/8 in. Hole Saw (Obtain Locally)
1 in. Npt Pipe Tap (Obtain Locally)



22756

a - Access Hole Plugs

1. Lubricate upper swivel shaft with a liberal amount of 2-4-C Marine Lubricant. This will help to prevent metal chips from getting into bearings when cutting holes.



23254

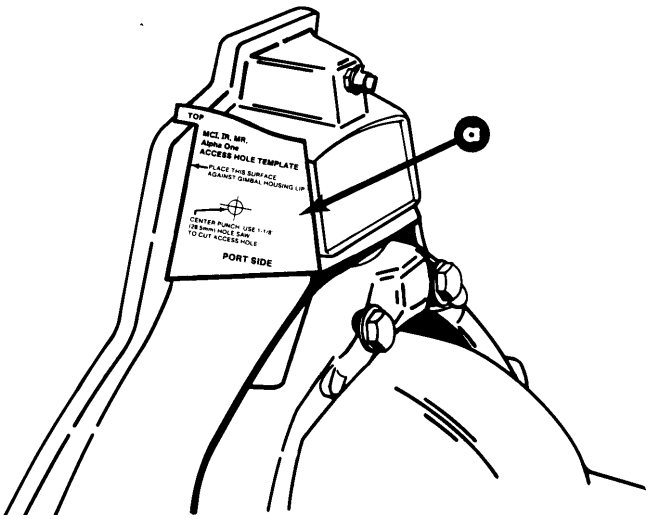
a - Swivel Shaft Grease Fitting (Not Present On Later Models)

2. Cut out template provided with Access Plug Kit.

⚠CAUTION

Be sure to position template correctly when marking access hole drilling locations. If holes are not located properly, it will not be possible to remove upper swivel shaft without complete transom assembly removal.

3. Position templates on gimbal housing and mark drilling locations (port and starboard) using a center punch.


TOP
MCI JR. MR. Alpha One ACCESS HOLE TEMPLATE
PLACE THIS SURFACE AGAINST GIMBAL HOUSING LIP
CENTER PUNCH, USE 1-1/8 (28.5mm) HOLE SAW TO CUT ACCESS HOLE
PORT SIDE
a

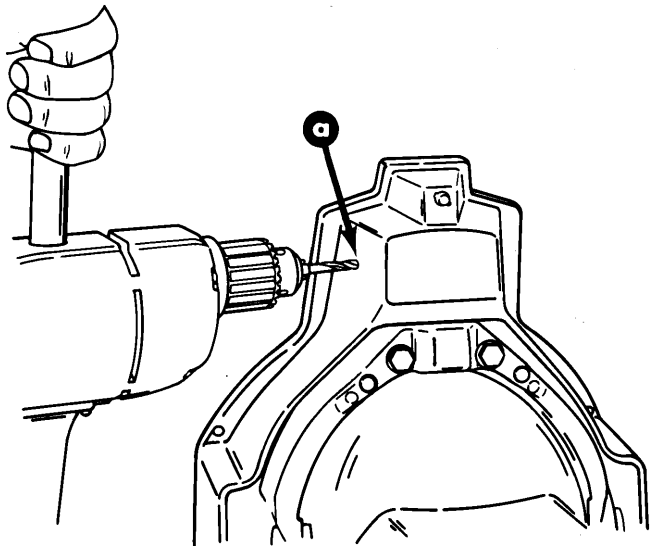
23363

a - Template (Port Side Shown)

⚠ CAUTION

Be sure to drill holes and tap threads perpendicular to gimbal housing surfaces in the following steps.

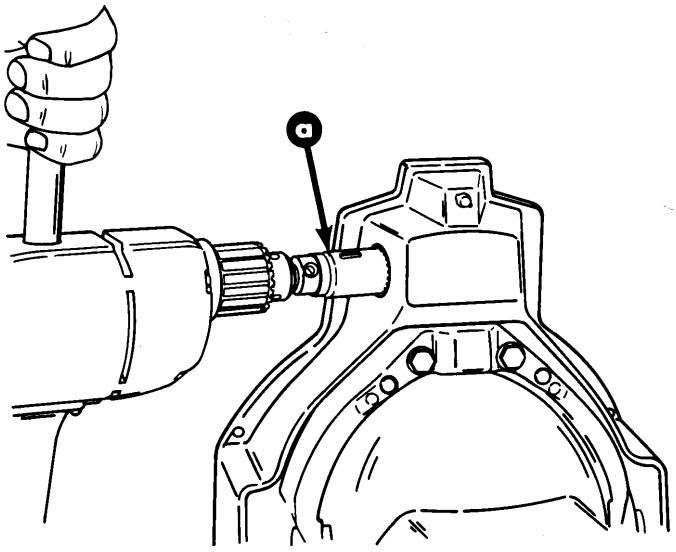
4. Drill pilot holes (port and starboard) using a drill that is the same size as pilot rod being used with hole saw. (Approximately 1/4 in.).



50540

a - Drill Pilot Hole

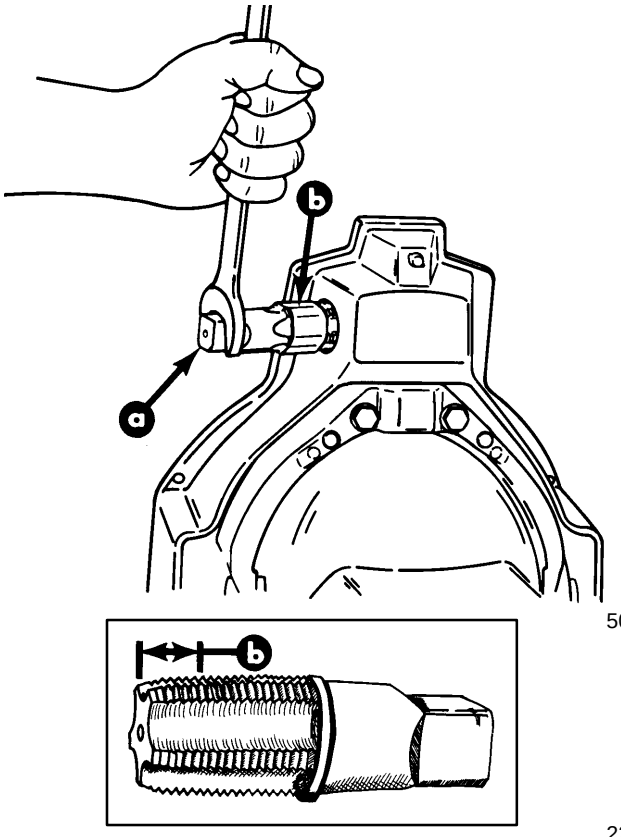
5. Cut holes in gimbal housing (port and starboard) using 1-1/8 in. hole saw with pilot rod. Remove metal chips with compressed air.



50540

a - Hole Saw

6. Mark 1 in. pipe tap with a piece of tape, 1/2 in. (13 mm) from end of tap. Coat pipe tap with grease to aid in picking up metal chips. Cut threads in access hole 1/2 in. (13 mm) of tap.



50540

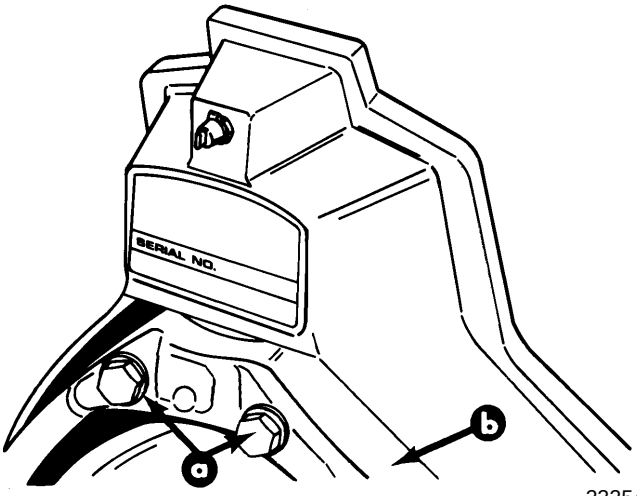
22757

a - 1 in. NPT PipeTap
b - Tape (1/2 in. From End)

7. Remove metal chips with compressed air or cloth.
8. Clean access hole threads with solvent. Dry with compressed air.

Gimbal Ring, Swivel Shaft and Steering Lever Removal

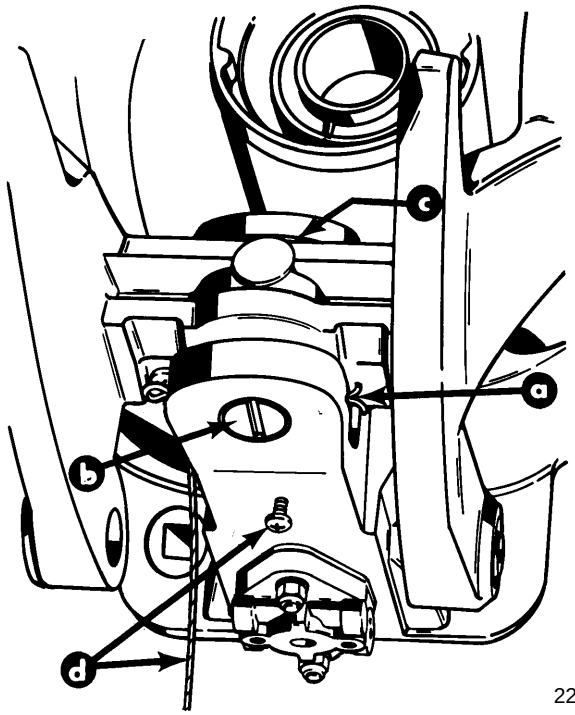
1. Loosen (not necessary to remove) screws and nuts.



23254

a - Screws (2)
Washers (4)
Nuts (2)
b - Gimbal Ring

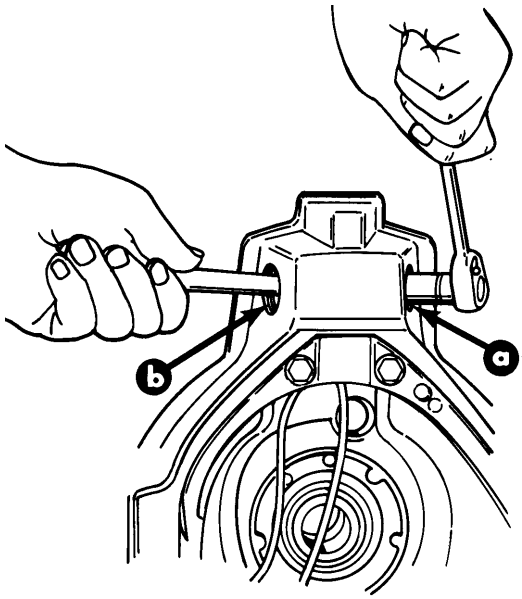
2. Remove cotter pin, lower swivel pin and washer. Disconnect continuity wire.



22461

a - Cotter Pin
b - Lower Swivel Pin
c - Washer
d - Continuity Wire

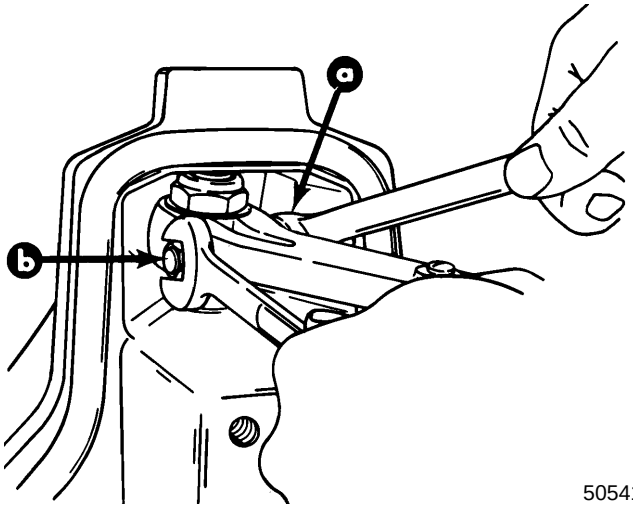
3. Loosen steering lever clamping screw and nut.



50541

With Engine and Transom Assembly Installed

a - Clamping Screw (Turn Through Access Hole)
b - Nut



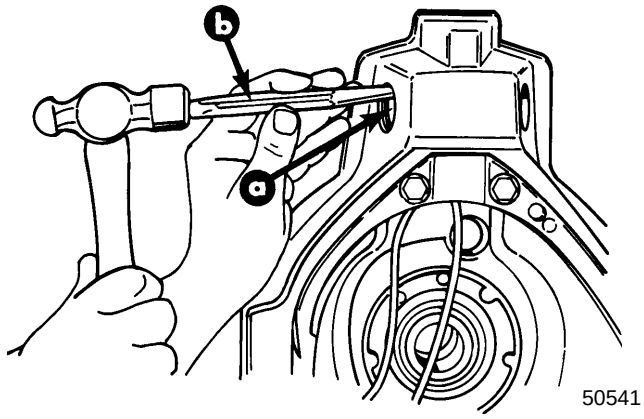
50541

With Engine and Transom Assembly Removed

c - Clamping Screw
d - Nut

NOTE: *It may be necessary to pull down on upper swivel shaft to completely unthread nut on swivel shaft.*

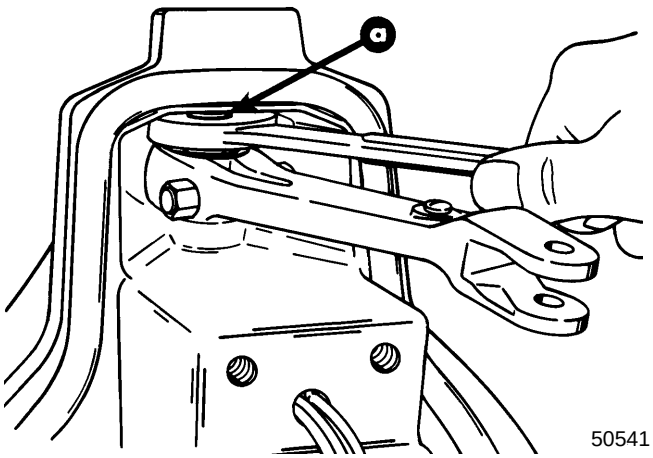
4. Unthread nut from top of upper swivel shaft.



50541

With Engine and Transom Assembly Installed

a - Nut
b - Pin Punch (Through Access Hole)

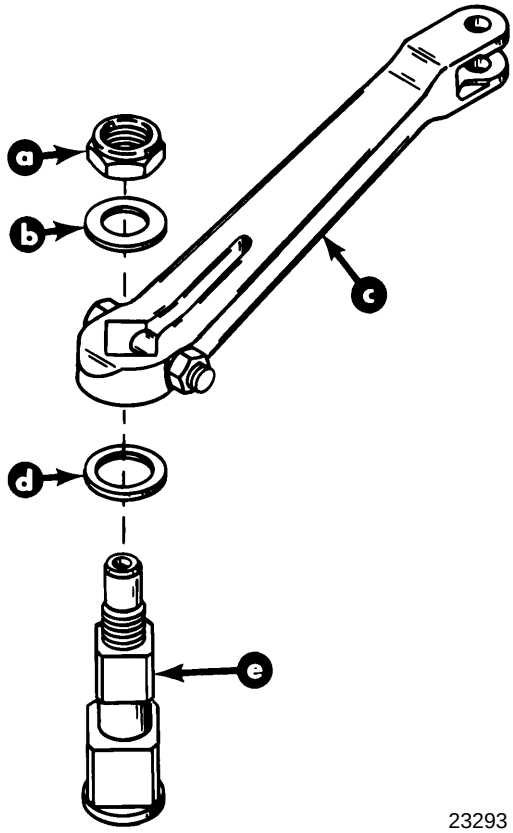


50541

With Engine and Transom Assembly Removed

a - Nut

5. Remove upper swivel shaft, steering lever and hardware shown. Remove gimbal ring.



23293

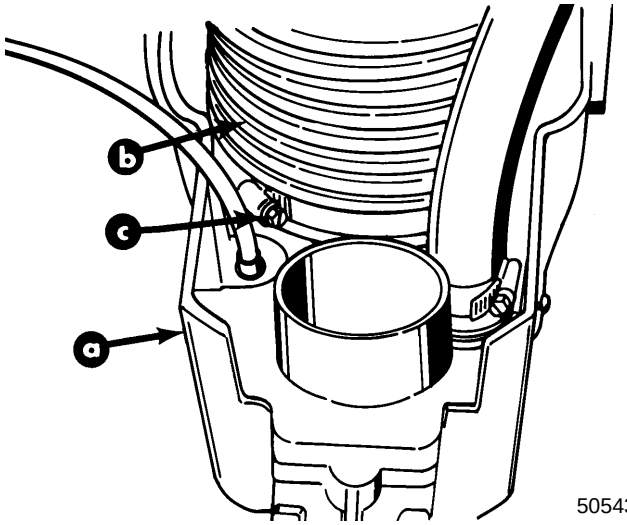
a - Nut
b - Washer (Small I.D.)
c - Steering Lever
d - Washer (Large I.D.)
e - Upper Swivel Shaft

Component Servicing

Bell Housing

U-JOINT BELLOWS

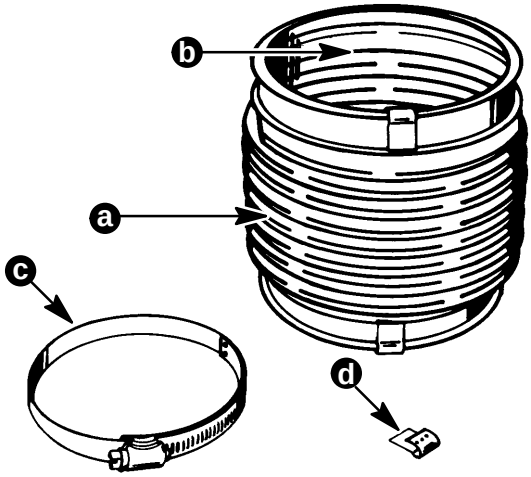
1. Loosen hose clamp and remove U-joint bellows from bell housing.



50543

a - Bell Housing
b - U-joint Bellows
c - Hose Clamp

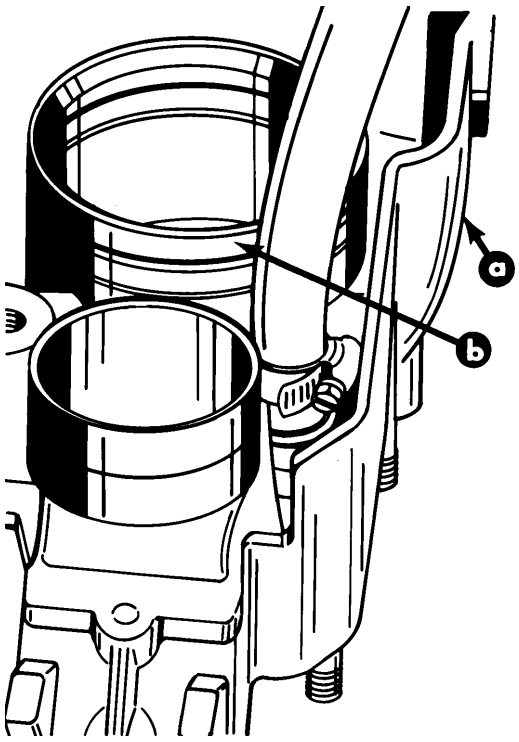
2. Remove old adhesive from U-joint bellows mounting surface, using lacquer thinner.



23364

a - U-joint Bellows
b - Mounting Surface
c - Clamp
d - Grounding Clip

3. Clean bell housing mounting flange with a wire brush or sandpaper. Wipe clean with lacquer thinner.



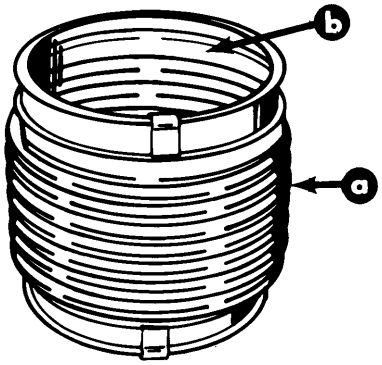
23361

a - Bell Housing
b - Mounting Flange

⚠WARNING

Be sure to read and follow package label directions when using bellows adhesive.

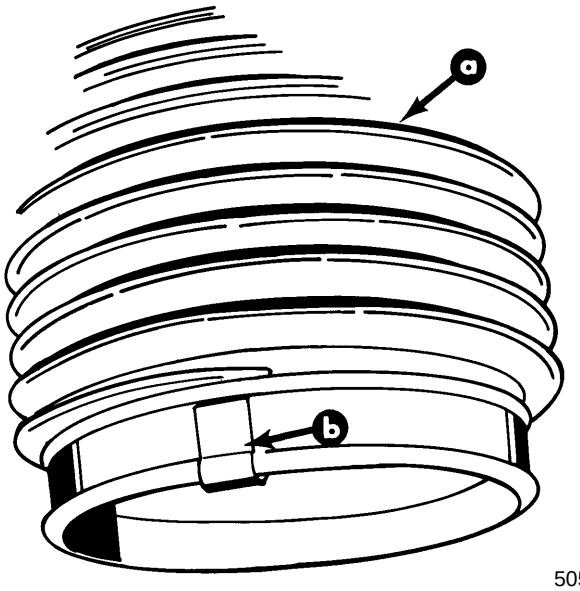
4. Apply bellows adhesive to U-joint bellows mounting surface. Allow to dry (approximately 10 minutes) until no longer tacky.



23364

a - U-joint Bellows
b - Mounting Surface

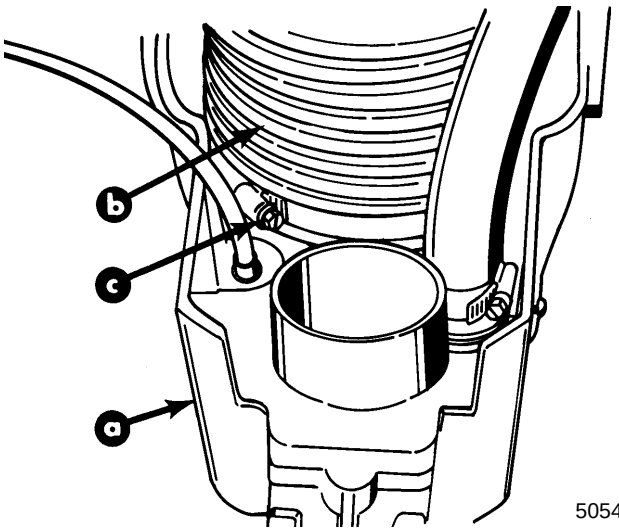
5. Position ground clips on U-joint bellows as shown. Then, position hose clamp on end of bellows marked “AFT-TOP”.



50542

a - U-joint Bellows
b - Ground Clips

6. Install U-joint bellows on bell housing. Be sure to position bellows according to “AFT-TOP” marking on bellows. Position hose clamp screw as shown and tighten securely.

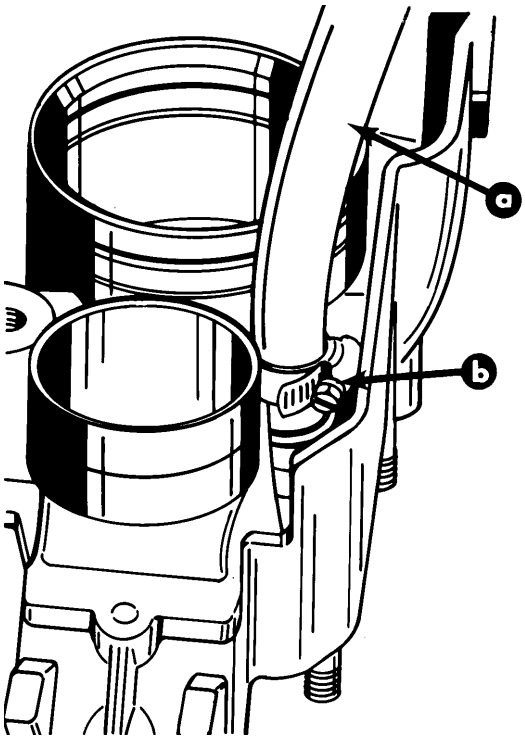


50543

a - Bell Housing
b - U-joint Bellows
c - Hose Clamp

WATER HOSE

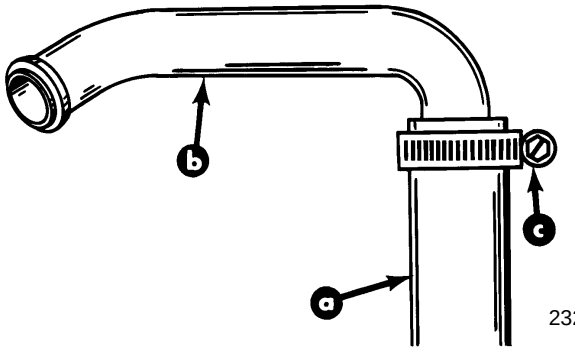
1. Loosen hose clamp and remove water hose from connector.



23361

a - Water Hose
b - Hose Clamp

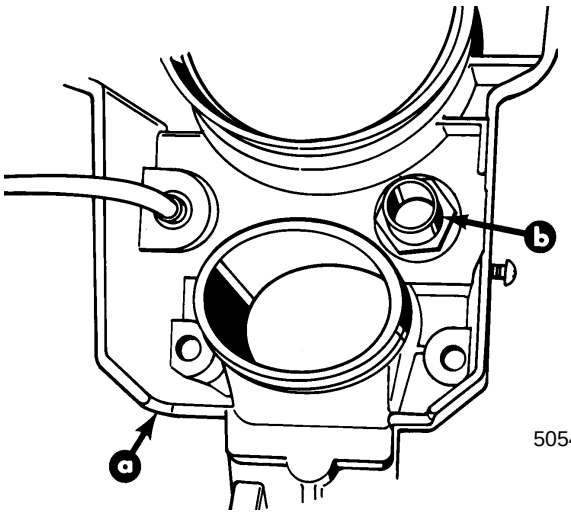
2. Loosen hose clamp and remove water tube from water hose.



23294

a - Water Hose
b - Water Tube
c - Hose Clamp

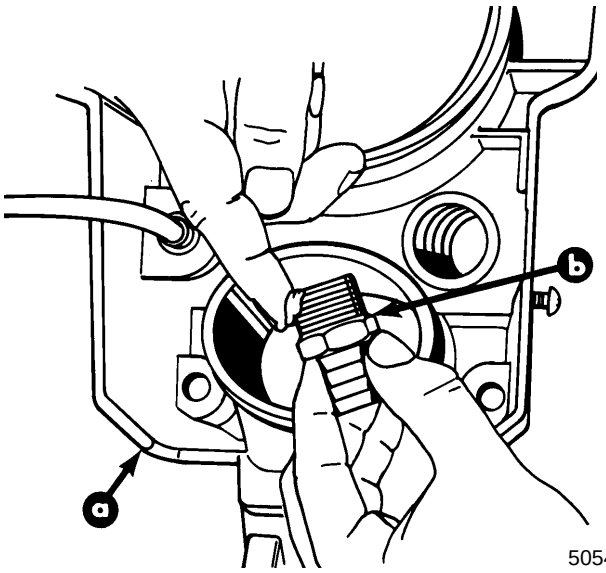
3. Remove water hose connector from bell housing.



50543

a - Bell Housing
b - Water Hose Connector

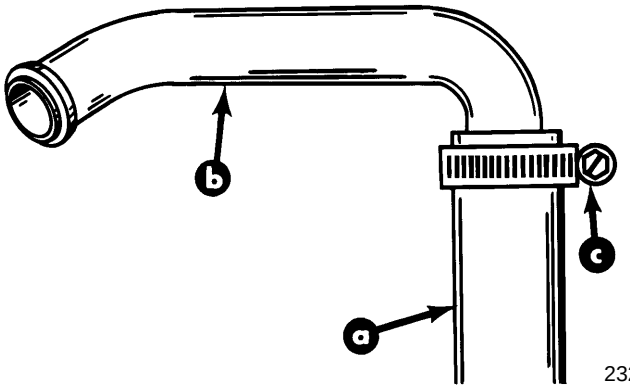
4. Apply Perfect Seal to threads of water hose connector and install in bell housing. Tighten securely.



50543

a - Bell Housing
b - Water Hose Connector

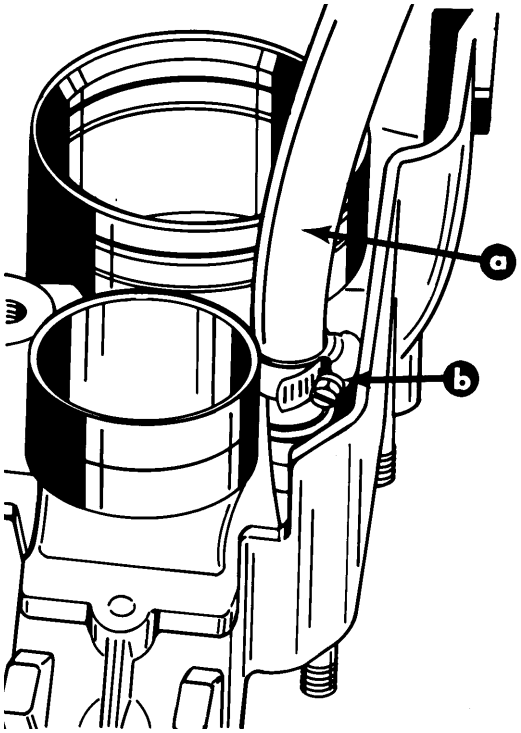
5. Connect water hose to water tube and position hose clamp as shown. Tighten securely.



23294

a - Water Hose
b - Water Tube
c - Hose Clamp

6. Connect water hose to connector on bell housing. Position hose and clamp as shown. Tighten securely.

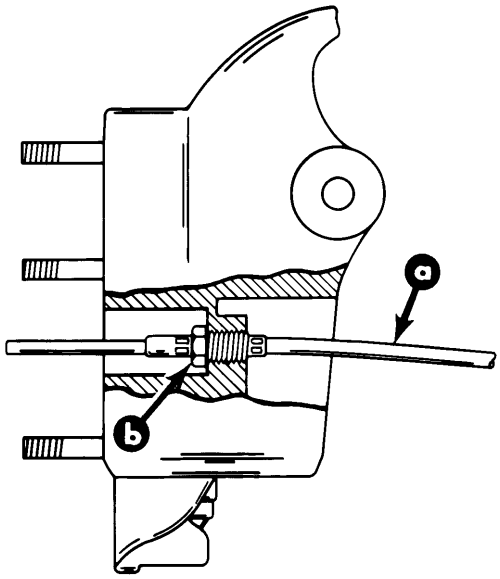


23361

a - Water Hose
b - Hose Clamp

SHIFT CABLE

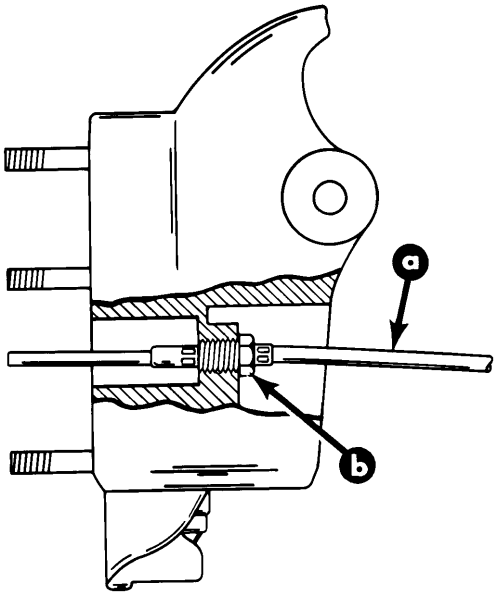
1. Loosen shift cable retaining nut using shift cable removal and installation tool and remove shift cable.



23156

Newer Style Shift Cable

a - Shift Cable
b - Retaining Nut - Use Tool (91-12037)

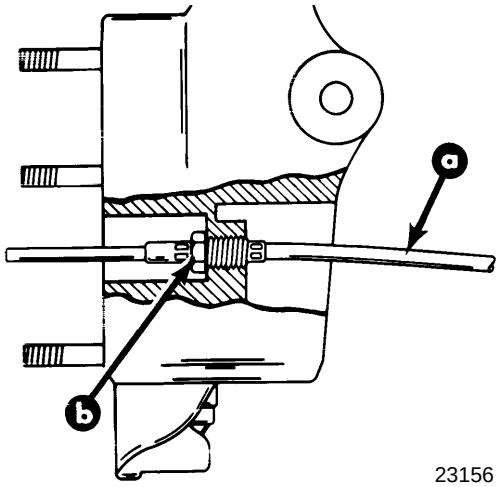


23169

Older Style Shift Cable

a - Shift Cable
b - Retaining Nut - Use Tool (91-12037)

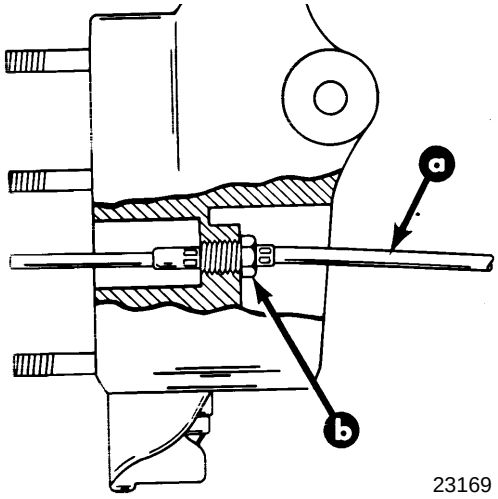
2. Apply Perfect Seal to threads of shift cable retainer and install shift cable. Tighten retainer securely using shift cable removal and installation tool (until no more than two threads of retainer are showing).



23156

Newer Style Shift Cable

a - Shift Cable
b - Retaining Nut - Use Tool (91-12037)



23169

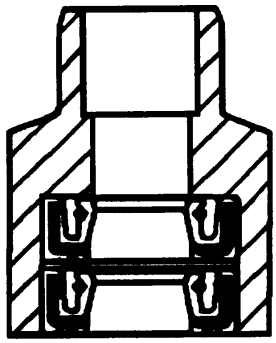
Older Style Shift Cable

a - Shift Cable
b - Retaining Nut - Use Tool (91-12037)

SHIFT SHAFT

All units built after serial number 0D644650 will have the following bushing installed. The seals were previously installed into the bell housing upper bore. They now are already installed in the bushing and can be installed with one procedure using Bushing Tool 91-805057A2.

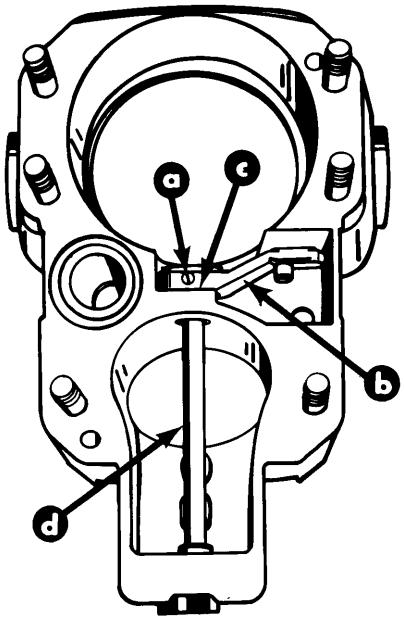
23-805041A2



71227

NOTE: *It may be necessary to apply heat to shift shaft lever screw to aid in removing.*

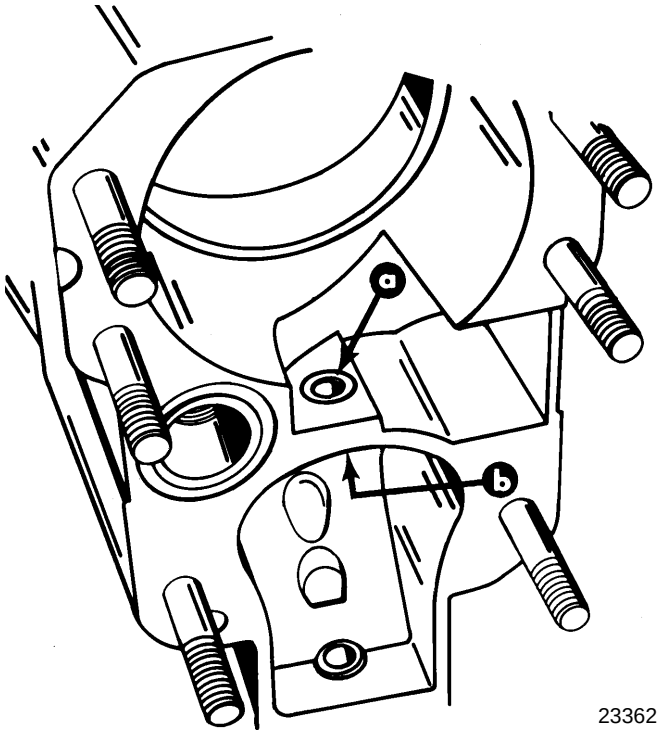
1. Remove upper shift shaft lever and shift shaft.



23362

a - Upper Shift Shaft Lever Screw
b - Upper Shift Shaft Lever
c - Washer (Beneath Lever)
d - Upper Shift Shaft

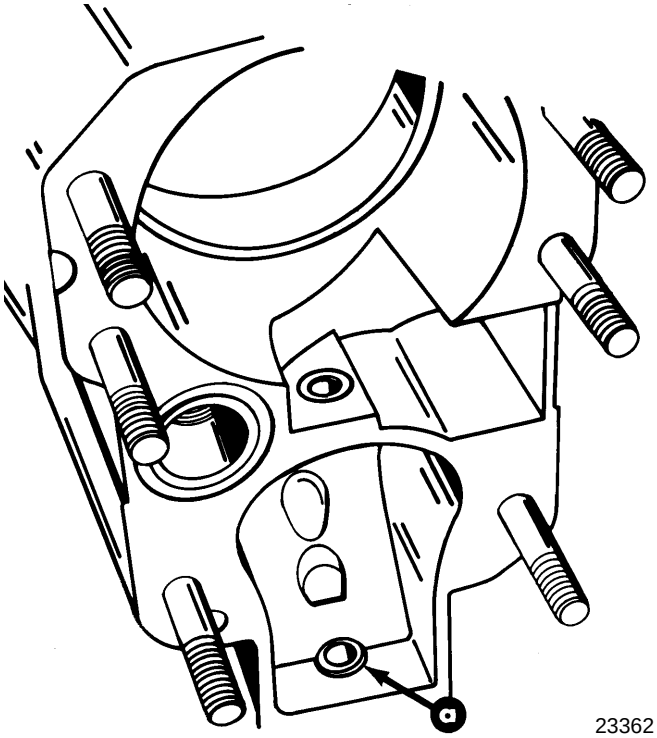
2. Remove shift shaft oil seal and upper bushing.



23362

a - Bushing
b - Oil Seal (Below Bushing)

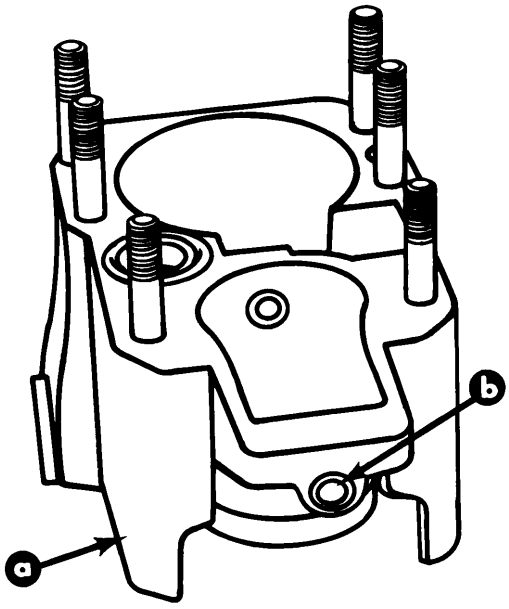
3. Remove shift shaft lower bushing.



23362

a - Bushing

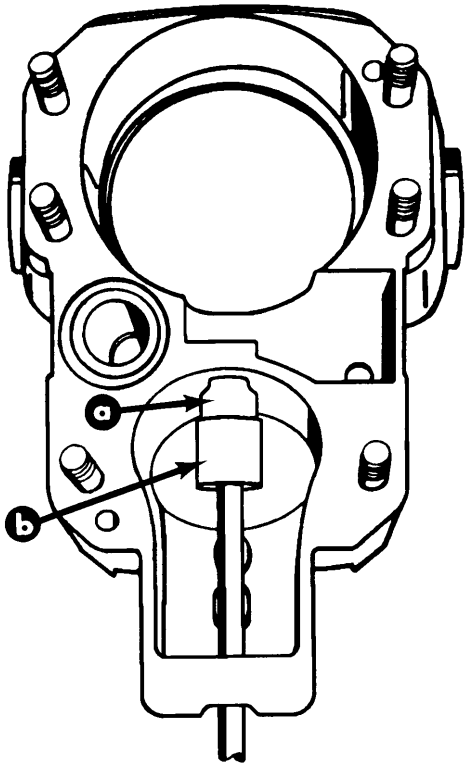
4. Apply a small amount of Special Lubricant 101 to O.D. of shift shaft lower bushing. Install bushing flush with bottom of the bore in bell housing.



70181

a - Bell Housing
b - Bushing

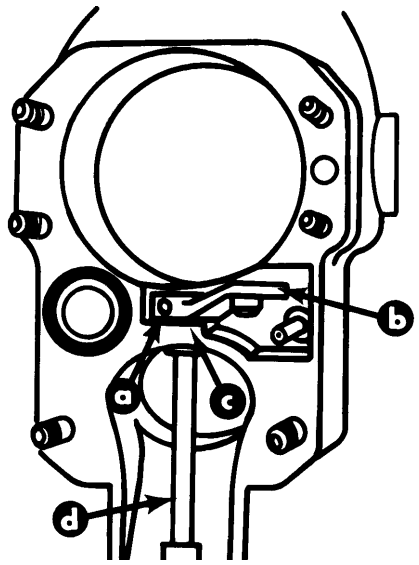
5. Apply Lubricant 101 to O.D. of bushing and install shift shaft upper bushing in bore from bottom using bushing installation tool.



70982

a - Upper Bushing
b - Bushing Installation Tool (90-805057A2)

6. Install upper shift shaft lever and shift shaft. Apply Loctite 27131 to screw threads. Tighten securely.

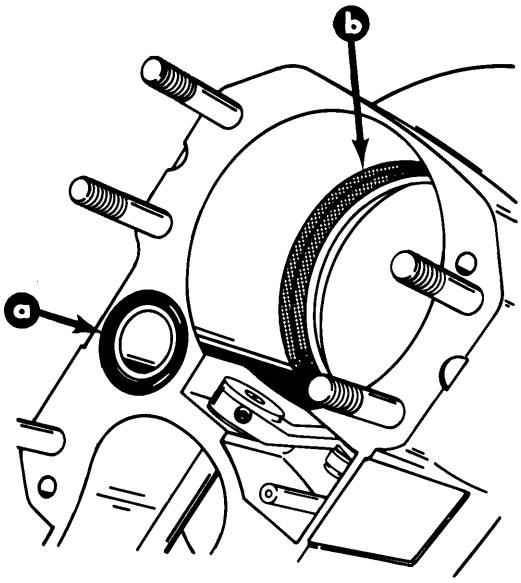


70141

a - Upper Shift Shaft Lever Screw
b - Upper Shift Shaft Lever
c - Washer (Beneath Lever)
d - Upper Shift Shaft

GASKET AND O-RING

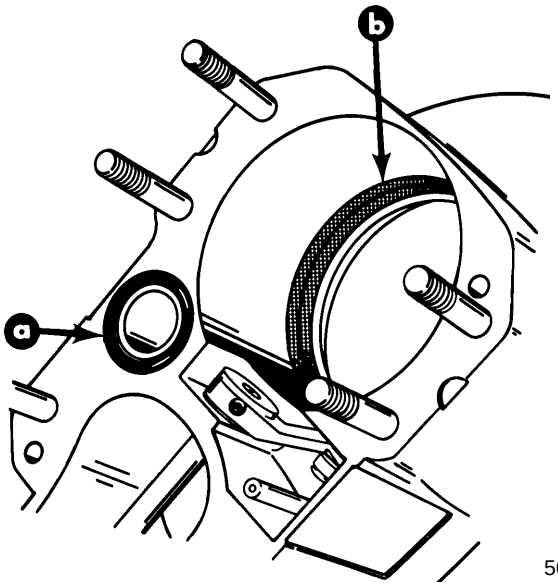
1. Remove U-joint bore rubber gasket and water passage O-ring.



50543

a - O-ring
b - Rubber Gasket

2. Install rubber gasket in U-joint bore. Install O-ring in groove at water passage opening.



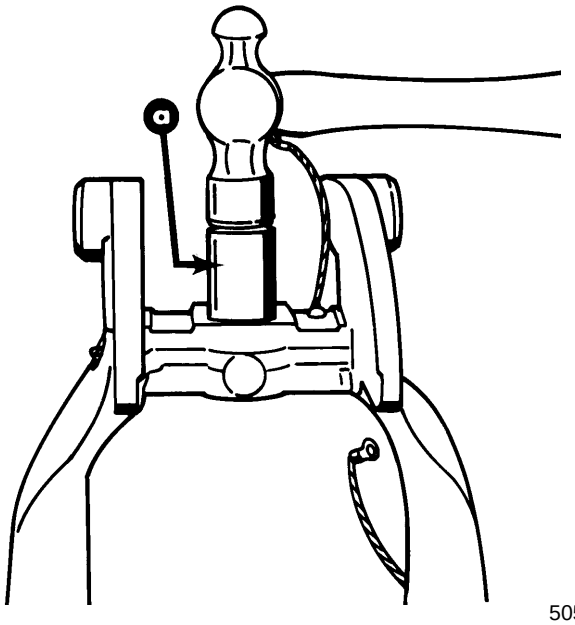
50543

a - O-ring
b - Rubber Gasket

Gimbal Ring

BEARING AND SEALS (EARLIER STYLE)

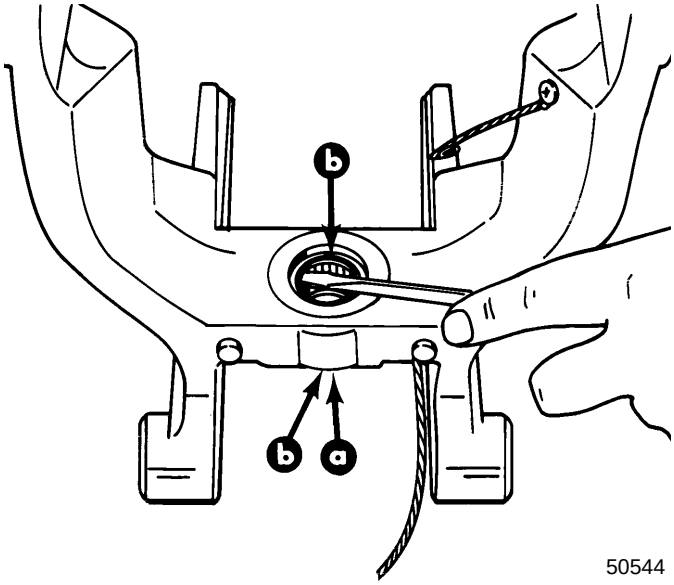
1. Remove bearing, seals and spacer using bearing and seal driver.



50544

a - Bearing and Seal Driver (P/N 91-33492)

2. If replacing seal(s) only, pry seals and spacer from gimbal ring.

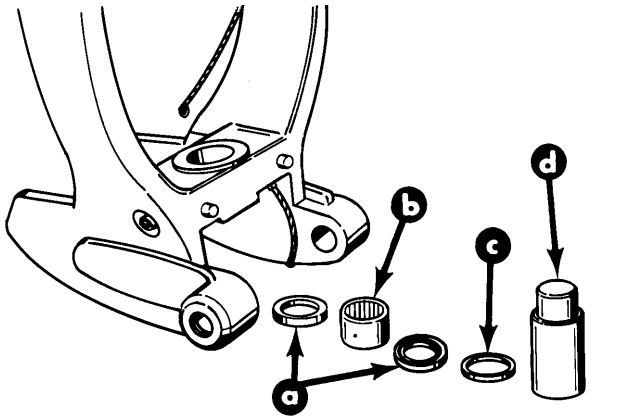


50544

a - Spacer
b - Seals

IMPORTANT: Ensure grease hole in bearing aligns with grease hole in gimbal ring, when installing bearing in the following step.

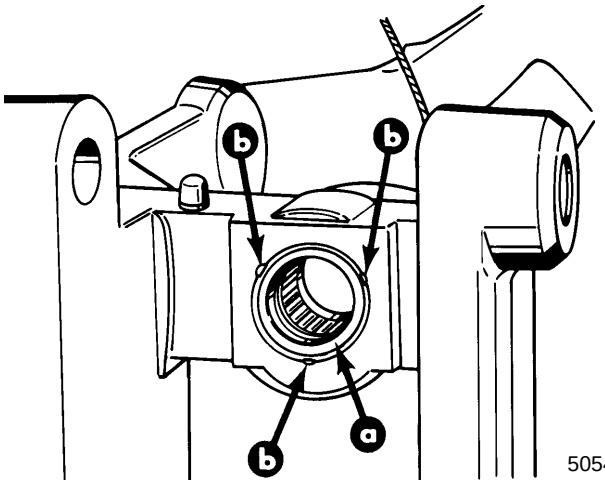
3. Install bearing and seals from bottom side of gimbal ring using bearing and seal driver. Ensure lips of both seals are facing up.



50540

a - Seals
b - Bearing
c - Spacer
d - Bearing And Seal Driver (91-33492)

4. Install spacer beneath lower seal. Stake in place using a flat punch.



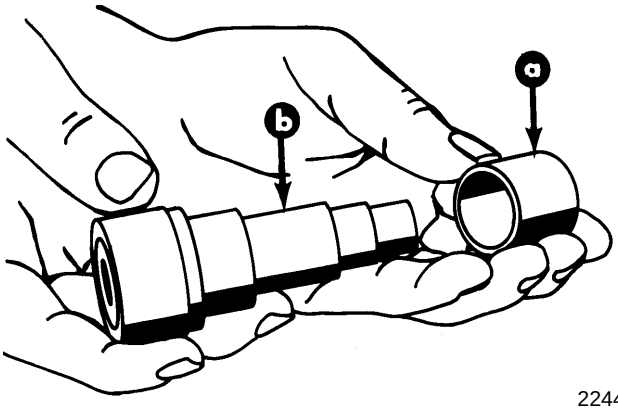
50542

a - Spacer
b - Stake Mark

BUSHING (LATER STYLE)

IMPORTANT: Later style gimbal ring lower swivel pin bushing can not be used on earlier style gimbal ring which used a needle bearing and two seals. Earlier style gimbal ring can be identified by the presence of a grease fitting.

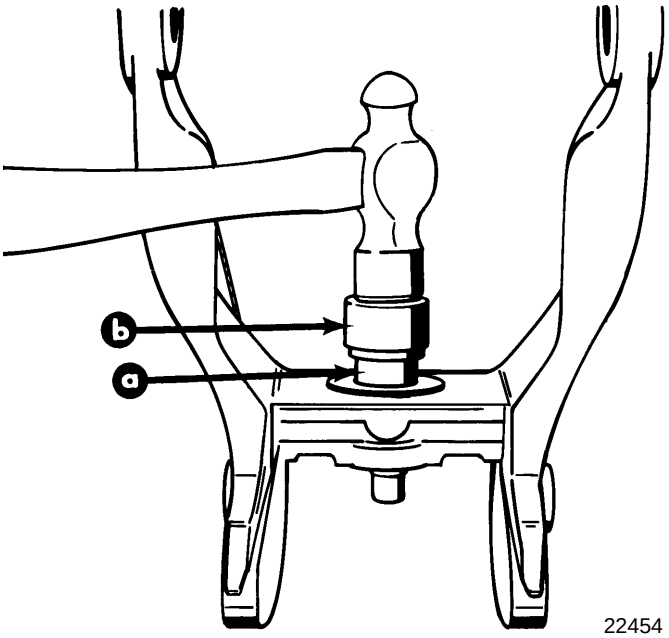
1. Remove bushing from gimbal ring using a suitable mandrel.
2. Install bushing as follows:
   a. Apply Epoxy (92-65150-1) to O.D. of bushing and position bushing on bearing and seal driver.



22440

a - Bushing
b - Bearing And Seal Driver (91-43578)

b. Install bushing in gimbal ring by tapping in place with a hammer.

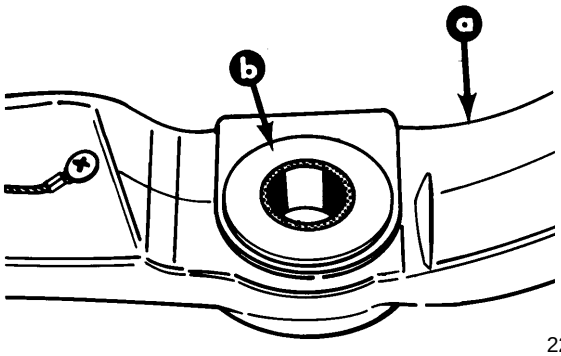


22454

a - Bushing
b - Bearing And Seal Driver (91-43578)

SYNTHANE WASHERS

1. If synthane washers are worn, remove and replace using Epoxy (92-65150-1).



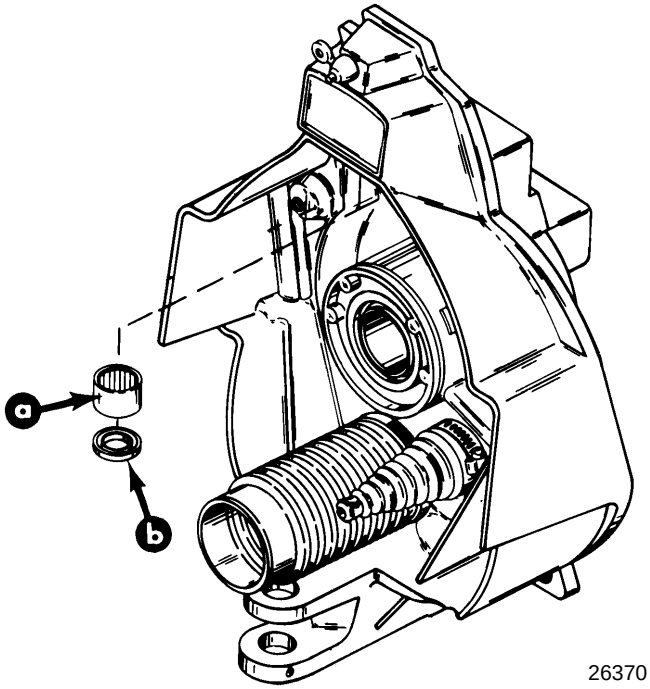
22454

a - Gimbal Ring
b - Synthane Washer (Port And Starboard)

Gimbal Housing

BEARINGS OR BUSHINGS AND SEALS

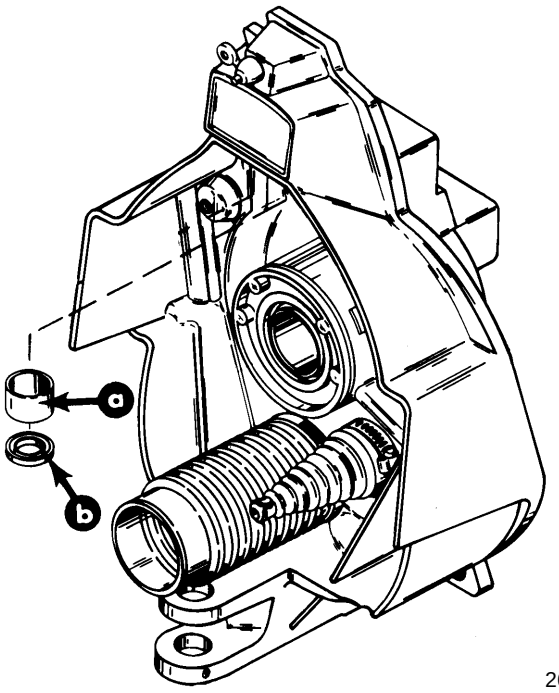
1. Remove larger bearing and oil seal or bushing and oil seal, by driving them up into steering lever cavity, using Bearing Driver (91-33491).



26370

Transom Assembly with Spline-Square Upper Swivel Shaft

a - Bearing
b - Oil Seal

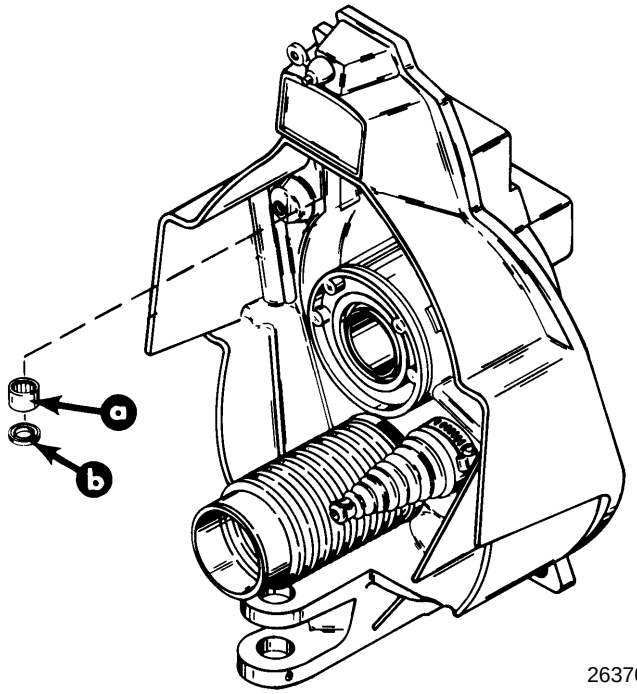


26370

Transom Assembly with Square-Square Upper Swivel Shaft

a - Bushing
b - Oil Seal

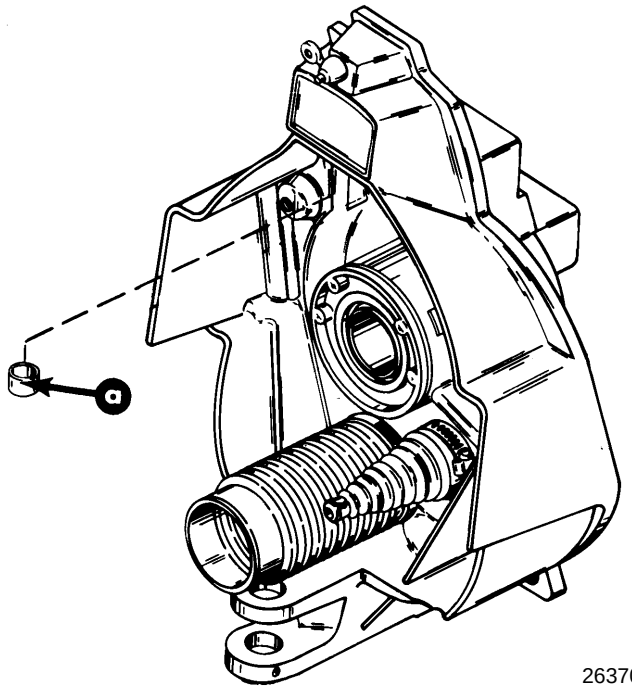
2. Remove smaller bearing and seal or bushing, by pulling down with appropriate puller.



26370

Transom Assembly with Spline-Square Upper Swivel Shaft

a - Bearing
b - Oil Seal

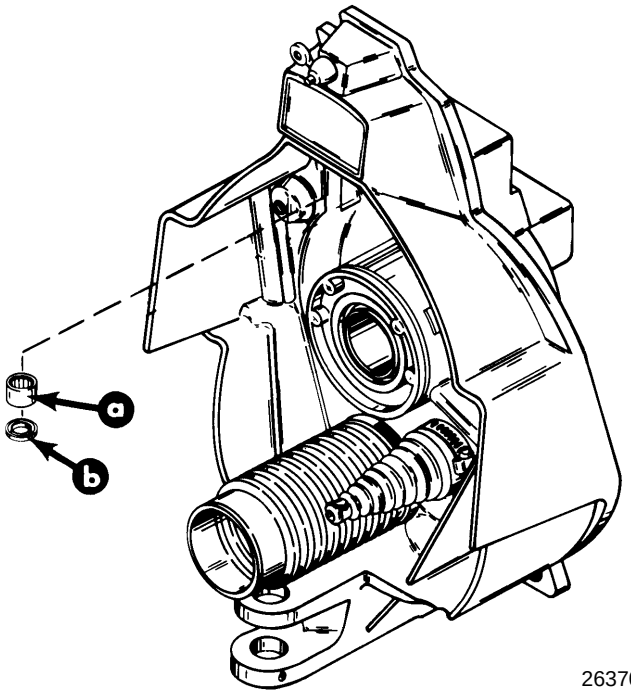


26370

Transom Assembly with Square-Square Upper Swivel Shaft

a - Bushing

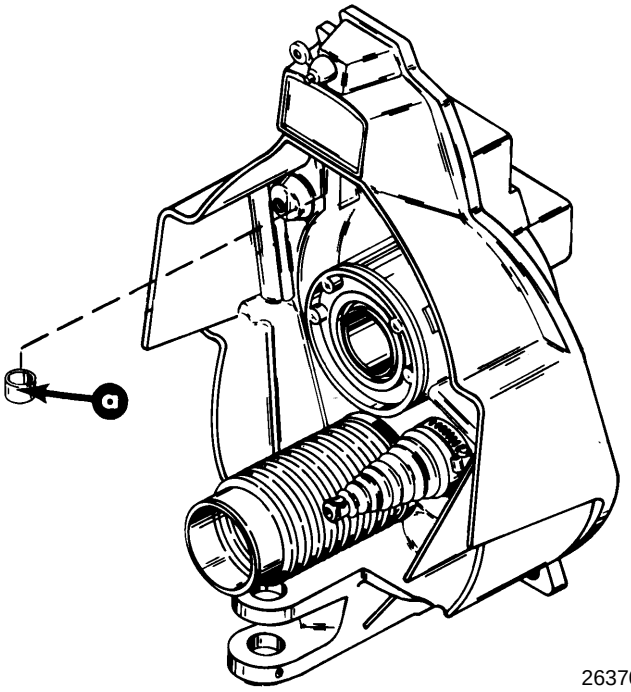
3. Install small bearing or bushing until it bottoms, using Driver (91-33489).
4. **On Spline-Square Swivel Shaft Units Only,** install small oil seal, with lip up, until flush with gimbal housing.



26370

Transom Assembly with Spline-Square Upper Swivel Shaft

a - Bearing
b - Oil Seal

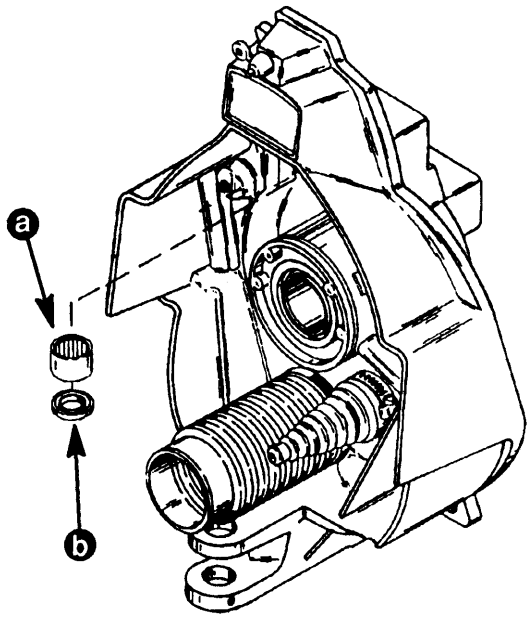


26370

Transom Assembly with Square-Square Upper Swivel Shaft

a - Bushing

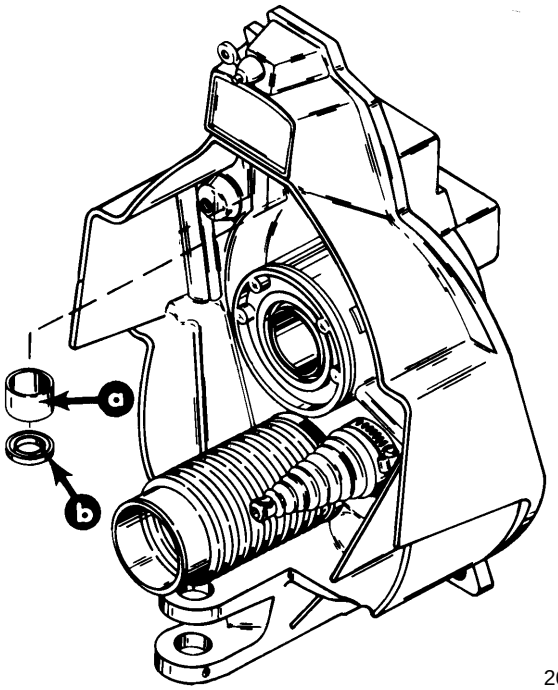
5. Install large bearing or bushing and oil seal, using Driver (91-33491).



73988

Transom Assembly with Spline-Square Upper Swivel Shaft

a - Large Bearing
b - Oil Seal



26370

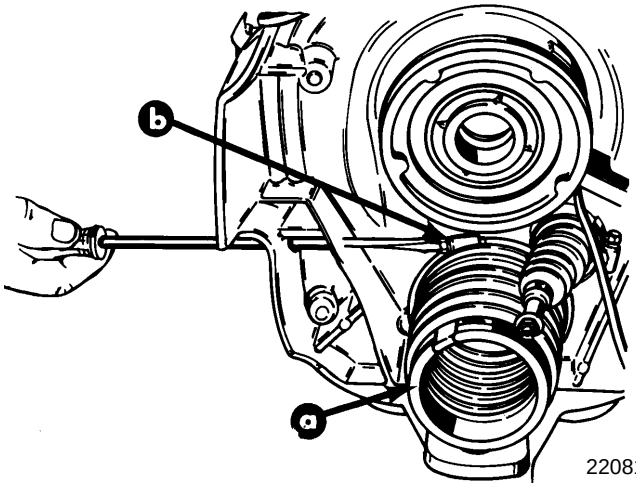
Transom Assembly with Square-Upper Swivel Shaft

a - Large Bushing
b - Oil Seal

IMPORTANT: Later model units may not have upper swivel grease fitting and do not require lubrication.

EXHAUST BELLOWS

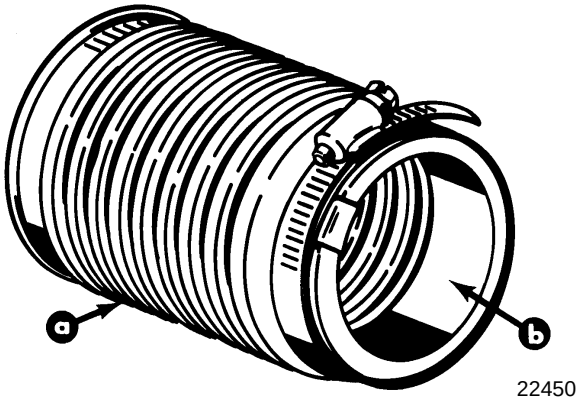
1. Loosen exhaust bellows clamp and remove bellows.



22081

a - Exhaust Bellows
b - Clamp

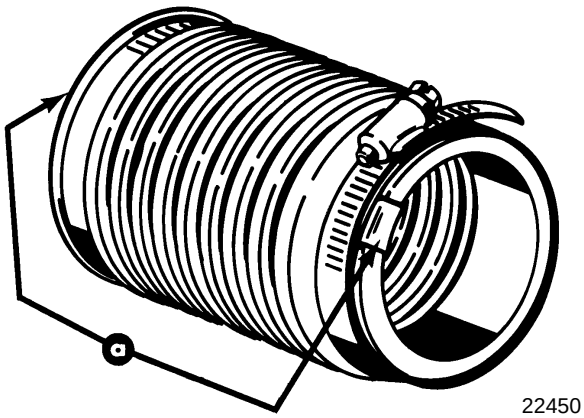
2. Clean old adhesive from exhaust bellows mounting surface using lacquer thinner.



22450

a - Exhaust Bellows
b - Mounting Surface

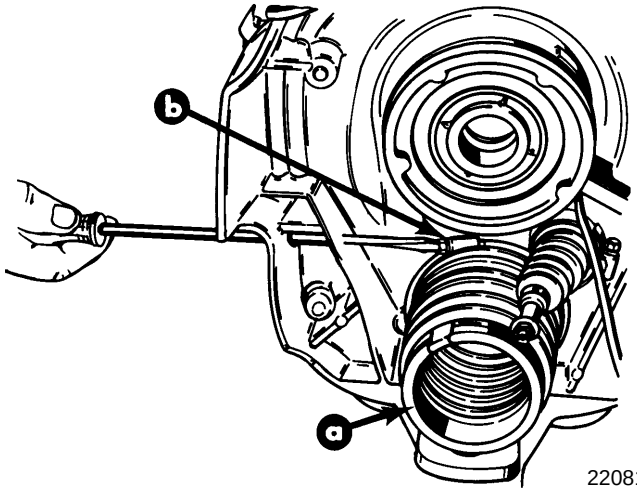
3. Position grounding clips on exhaust bellows as shown. Apply 3M Bellows Adhesive to both ends and let dry for 20-30 minutes before installing bellows.



22450

a - Grounding Clips

4. Clean exhaust bellows mounting flange with a wire brush or sandpaper. Wipe clean with lacquer thinner.
5. Install exhaust bellows on gimbal housing and position hose clamp as shown. Tighten securely.

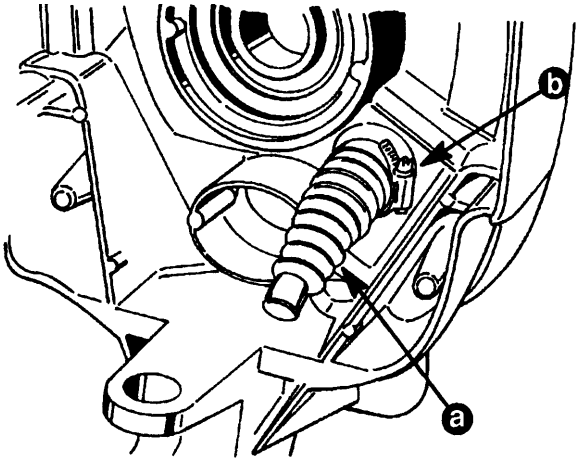


22081

a - Exhaust Bellows
b - Hose Clamp

SHIFT CABLE BELLOWS

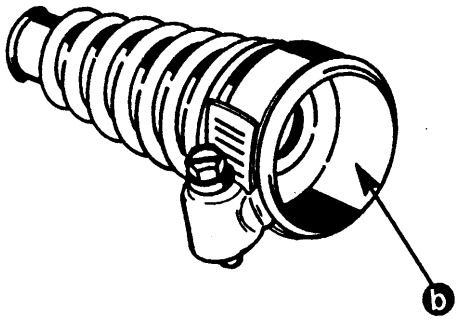
1. Loosen hose clamp and remove shift cable bellows.



73987

a - Shift Shaft Bellows
b - Hose Clamp

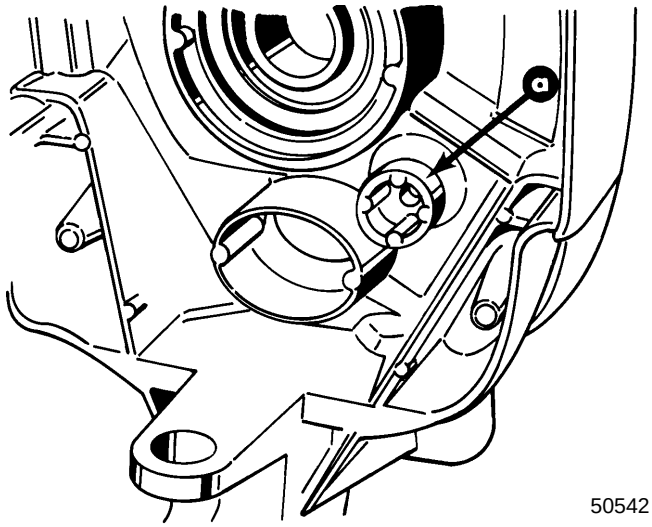
2. Clean old adhesive from shift cable bellows mounting surface, using lacquer thinner.
3. Apply 3M Bellows Adhesive to bellows and let dry for 20-30 minutes before installing bellows.



73986

a - Shift Cable Bellows
b - Mounting Surface

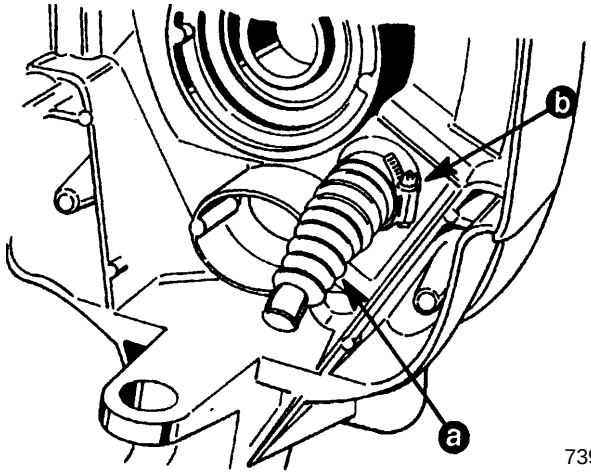
4. Clean shift cable bellows mounting flange with a wire brush or sandpaper and wipe clean with lacquer thinner.



50542

a - Mounting Flange

5. Install shift cable bellows on gimbal housing. Position hose clamp as shown. Tighten securely.

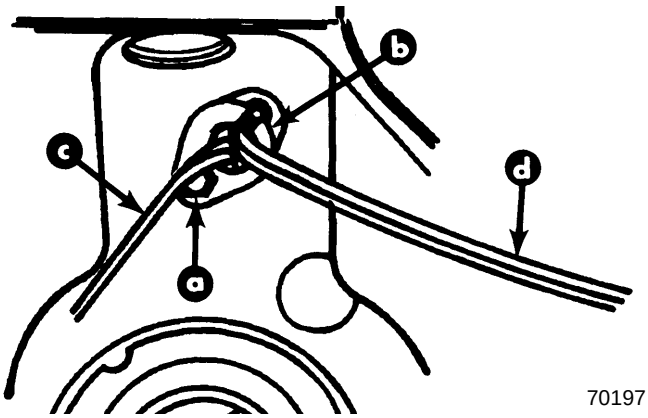


73987

a - Shift Cable Bellows
b - Hose Clamp

TRIM POSITION SENDER AND TRIM LIMIT SWITCH WIRE REPLACEMENT

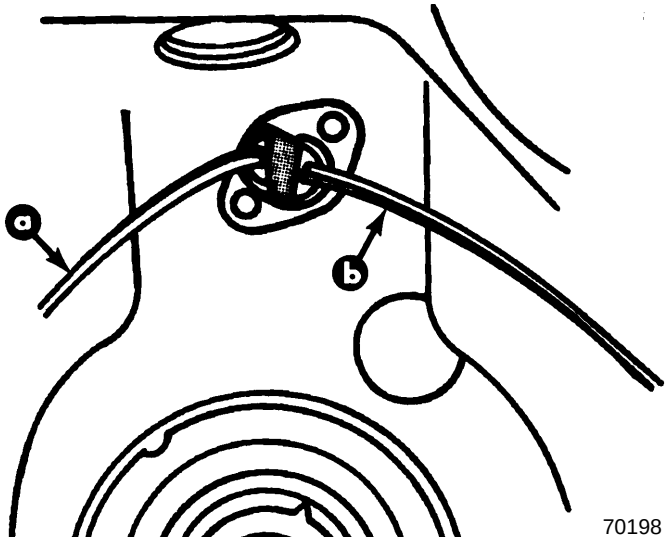
1. Remove trim limit switch wires and trim position sender wires.



70197

a - Screw
b - Trim Harness Clamp - Remove
c - Trim Limit Switch Wires
d - Trim Position Sender Wires

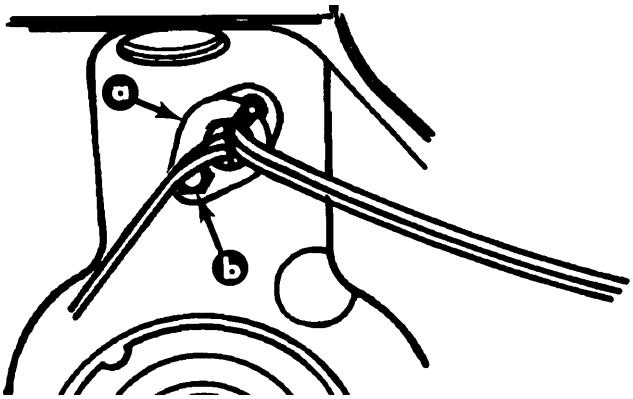
2. Install trim limit switch wires and trim position sender wires. DO NOT pinch wires.



70198

a - Trim Limit Switch Wires
b - Trim Position Sender Wires

3. Apply Perfect Seal to threads of screw and install trim harness clamp and screw.



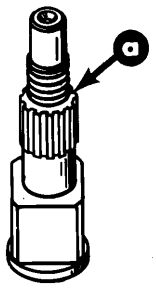
a - Trim Harness Clamp
b - Screw - Torque 90 - 100 (10.2 - 11.3 N·m)

70197

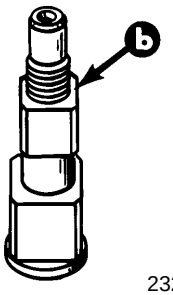
Component Reassembly

Gimbal Ring, Swivel Shaft and Steering Lever Installation

NOTE: *Older models are equipped with a square/spline swivel shaft. Later models are equipped with a square/square swivel shaft.*



23296

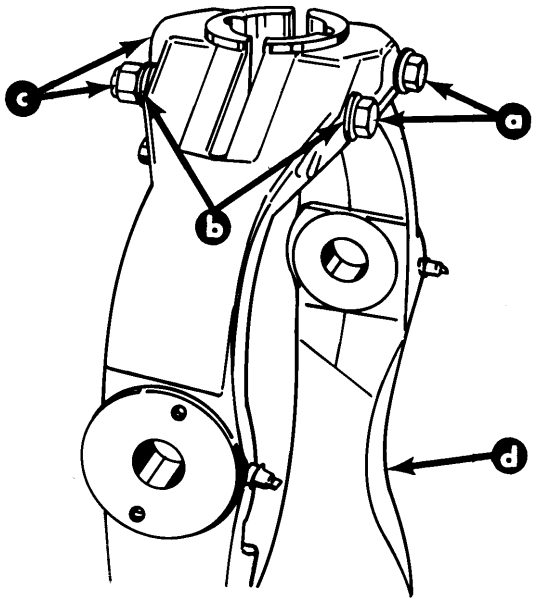


23293

a - Square/Spline Swivel Shaft
b - Square/Square Swivel Shaft

IMPORTANT: Square/Spline Swivel Shaft must be installed with flat on splines forward.

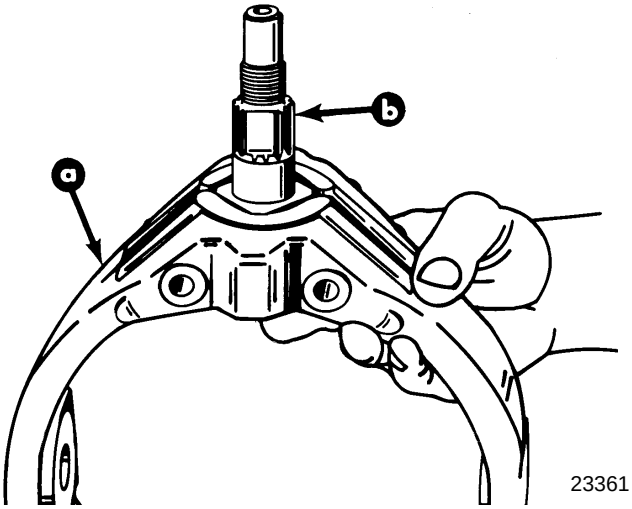
1. If removed, install gimbal ring screws with hardware shown. Do not tighten.



23364

a - Gimbal Ring Screws (2)
b - Washers (4)
c - Nuts (2)
d - Gimbal Ring

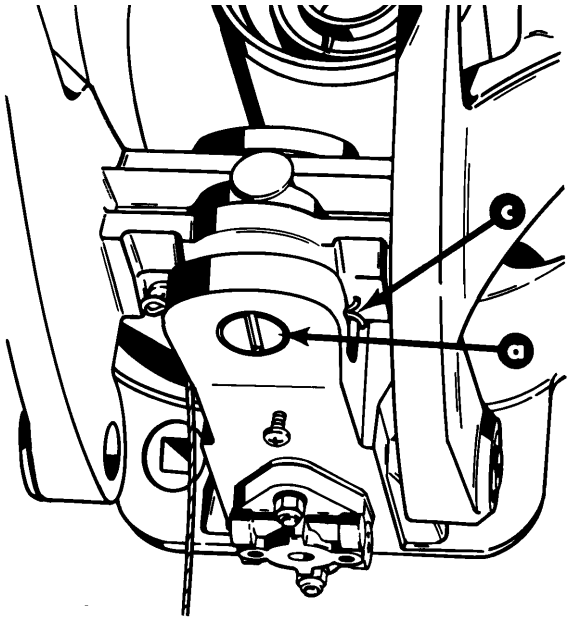
2. Coat upper swivel shaft with Special Lubricant 101. Check that upper swivel shaft fits all the way into gimbal ring. Shoulder on shaft must bottom out against ring. If necessary, clean up mating surfaces with a file.



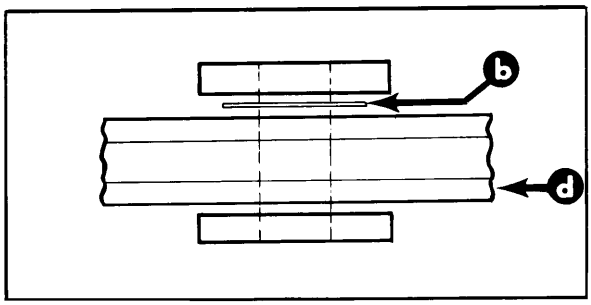
23361

a - Gimbal Ring
b - Swivel Shaft

3. Install lower swivel pin and washer and secure with cotter pin. Spread both ends.



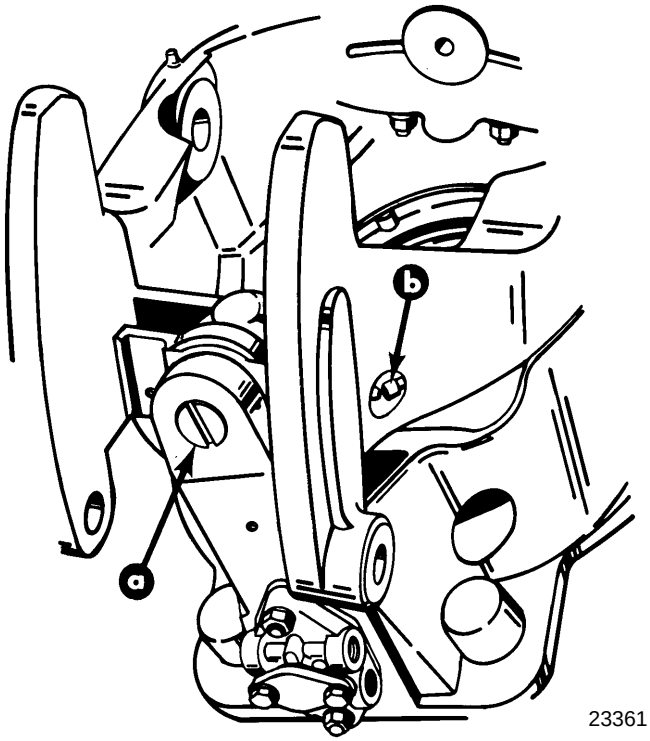
22461



22445

a - Lower Swivel Pin
b - Washer
c - Cotter Pin
d - Gimbal Ring

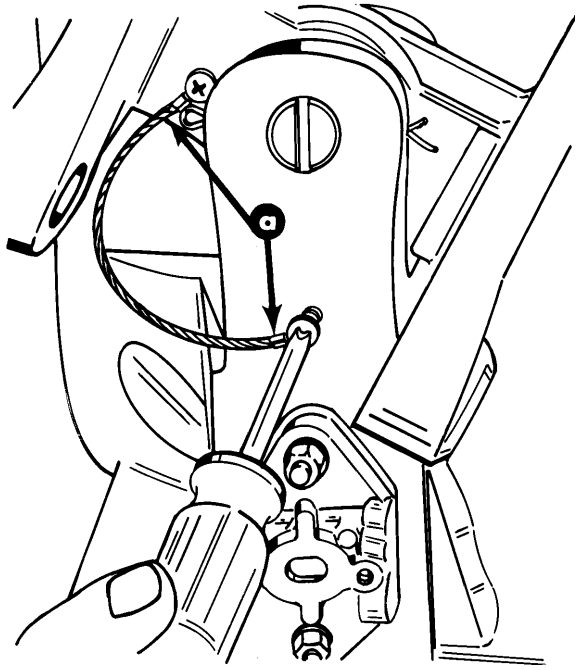
4. **Earlier Style Swivel Pin Bearing,** Lubricate with 2-4-C Marine Lubricant.



23361

a - Swivel Pin
b - Grease Fitting

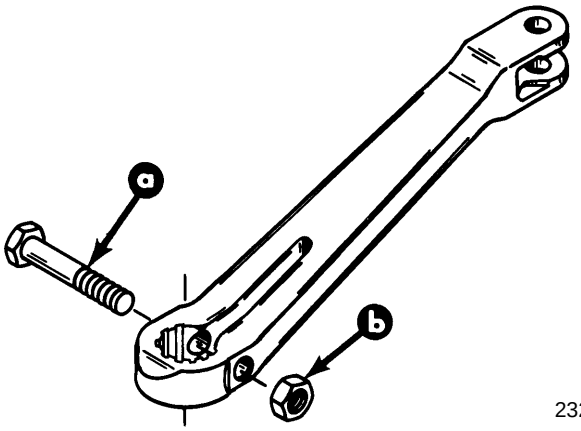
5. Connect continuity wire from gimbal housing to gimbal ring.



22261

a - Continuity Wire

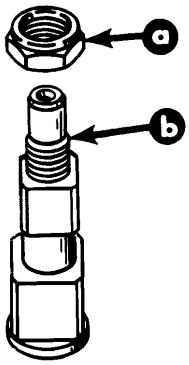
6. If removed, install clamping screw and nut on steering lever.



23293

a - Screw
b - Nut

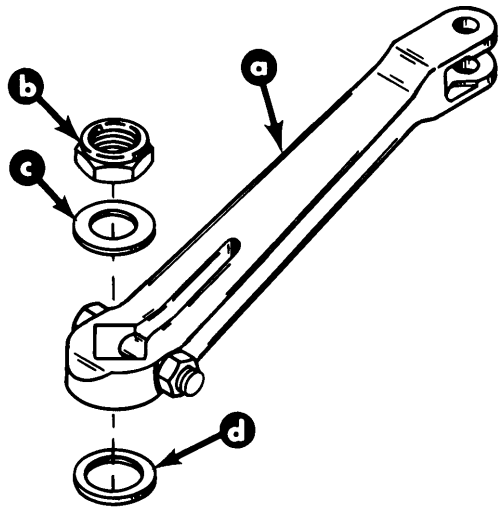
7. Thread new, grooved nut all the way onto swivel shaft (to cut threads). Remove nut.



23293

a - Nut
b - Swivel Shaft

8. Place steering lever, new nut and washers in position in steering cavity.

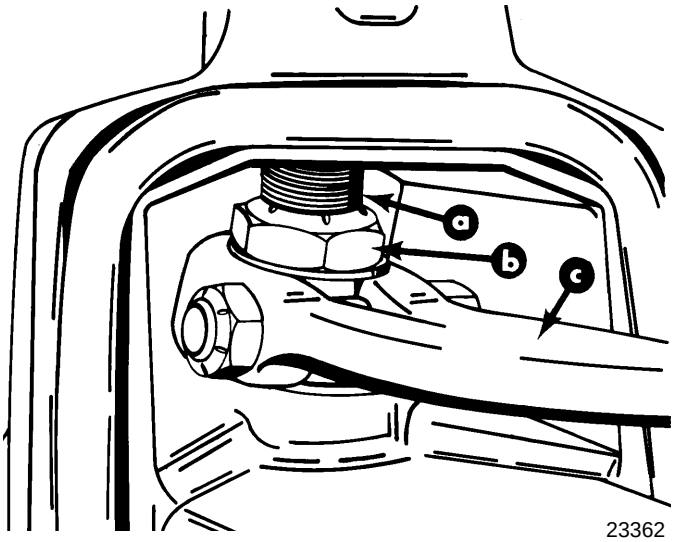


23293

a - Steering Lever
b - Nut
c - Small I.D. Washer
d - Large I.D. Washer

IMPORTANT: When installing upper swivel shaft through gimbal ring and steering lever, be sure that gimbal ring is straight and steering lever is pointed straight forward.

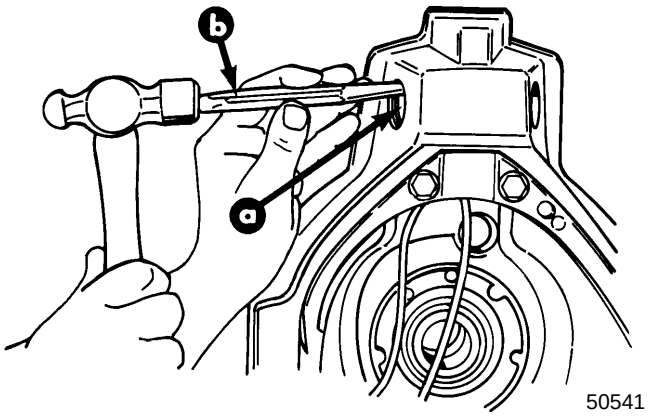
9. Install swivel shaft through gimbal rings and up through steering lever. Start nut on swivel shaft.



23362

a - Swivel Shaft
b - Nut
c - Steering Lever (Washer On Top And Bottom)

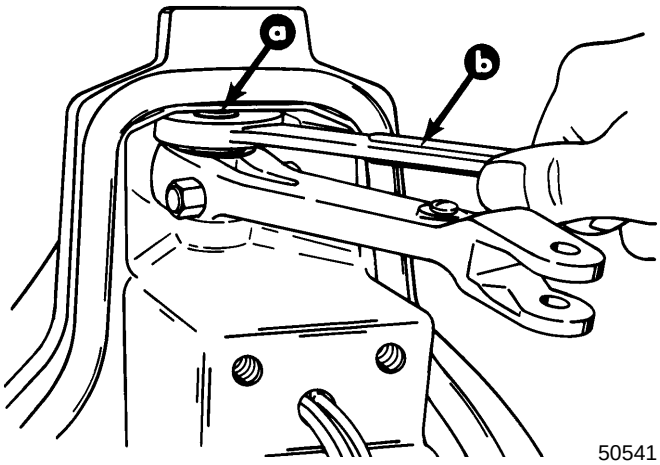
10. Tighten nut until a clearance of .002 - .010 in. (0.05 - 0.25 mm) exists between lower swivel pin washer and gimbal housing mount.



50541

Engine and Transom Assembly Installed

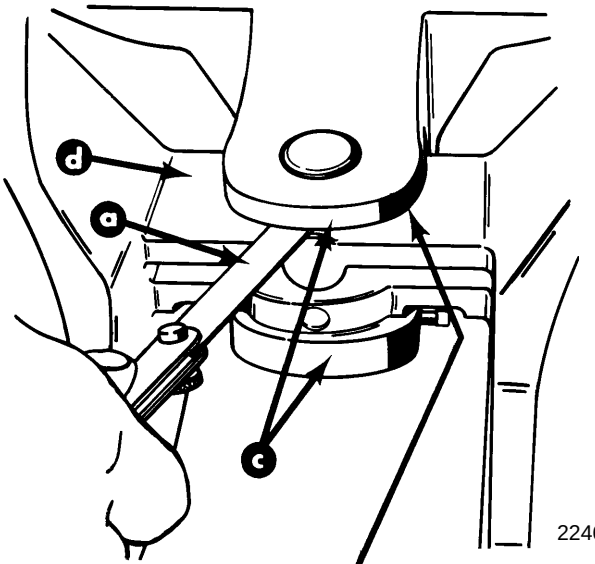
a - Nut (From Kit)
b - Pin Punch



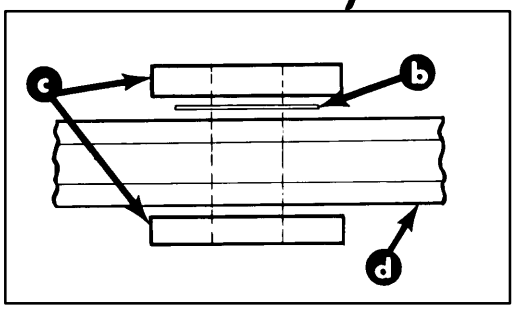
50541

Engine and Transom Assembly Removed

a - Nut
b - Wrench (1-1/16 in.)



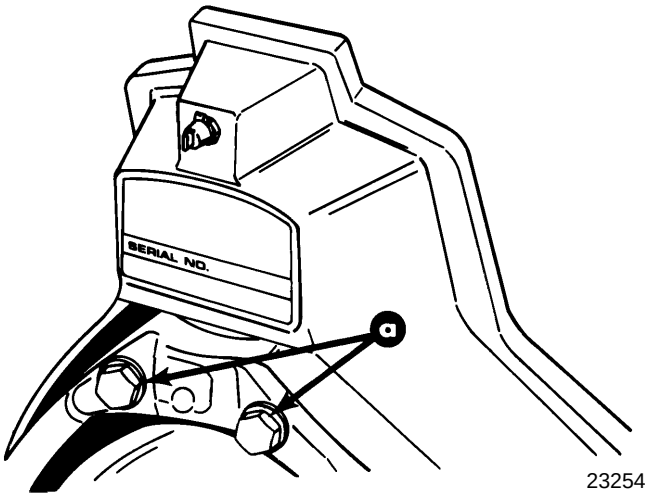
22461



22445

a - Feeler Gauge - .002-.010 in. (0.05-0.25 mm)
b - Washer
c - Gimbal Housing Mount
d - Gimbal Ring

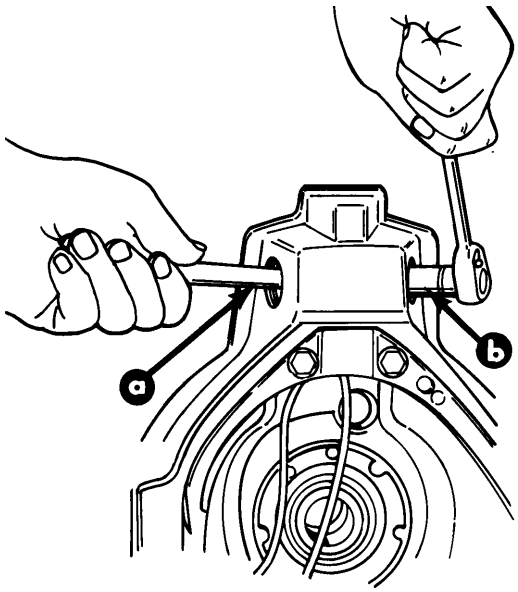
11. Strike down on gimbal ring flanges using a rawhide mallet. Recheck clearance and tighten swivel shaft nut as necessary.
12. Torque gimbal ring screws to 55 lb. ft. (74.6 N·m).



23254

a - Gimbal Ring Screws (Nuts Not Seen)

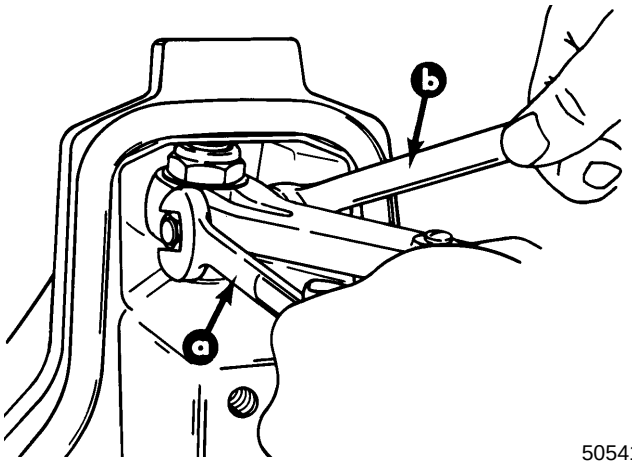
13. Tighten steering lever clamping screw and nut. Torque to 60 lb. ft. (81 N·m).



50541

Engine and Transom Assembly Installed

a - Wrench
b - Socket Wrench

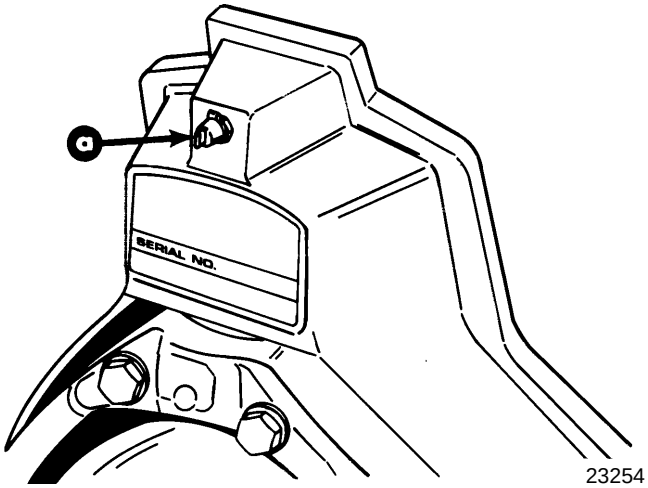


50541

Engine and Transom Assembly Removed

a - Wrench
b - Wrench

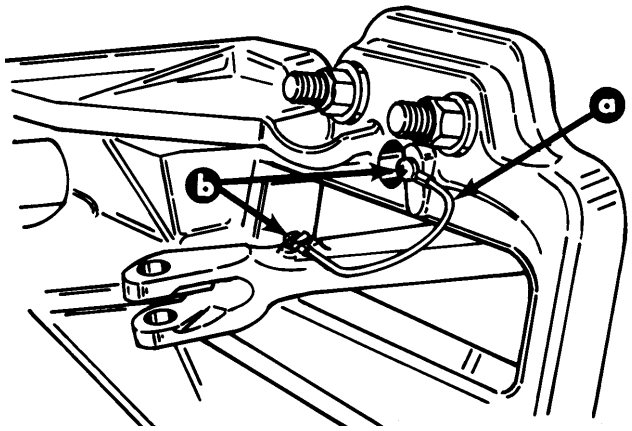
14. Lubricate upper swivel shaft (through grease fitting) with 2-4-C Marine Lubricant on models equipped with grease fitting.



23254

a - Grease Fitting (Not Present On Later Models)

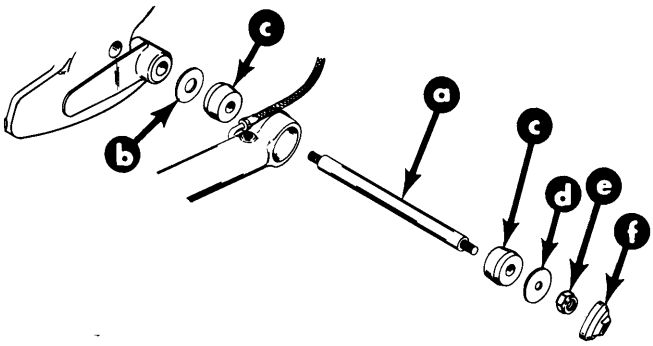
15. Install steering lever ground wire. Wire must be positioned exactly as shown.



22028

a - Ground Wire
b - Screws

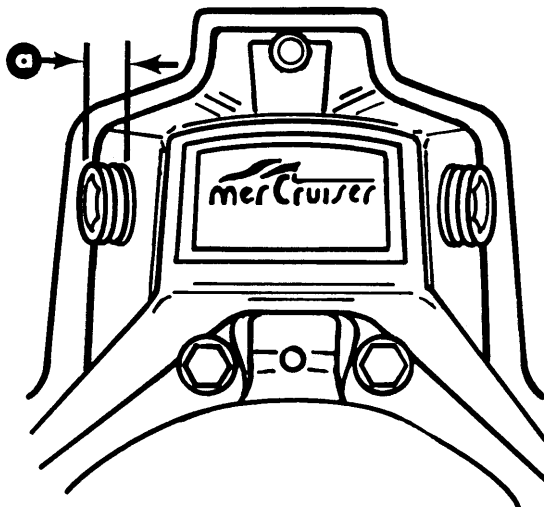
16. Install trim cylinders on gimbal ring.
17. Coat forward anchor pin with 2-4-C Marine Lubricant.
18. Tighten nuts until bottomed on anchor pin shoulder.



22948

a - Forward Anchor Pin (Longer) - Coat with 2-4-C Marine Lubricant
b - Washers (2) - Large I.D.
c - Rubber Bushings (4)
d - Washers (2) - Small I.D.
e - Nuts
f - Plastic Caps (2)

19. Coat threads of plastic plugs (if used) with Perfect Seal and thread into access holes until 3/8 in. (9 mm) of plug protrudes from gimbal housing as shown.



22550

a - Plastic Plug - 3/8 in. (9 mm) of plug protrudes

20. Touch up any bare metal spots with primer and appropriate spray paint.

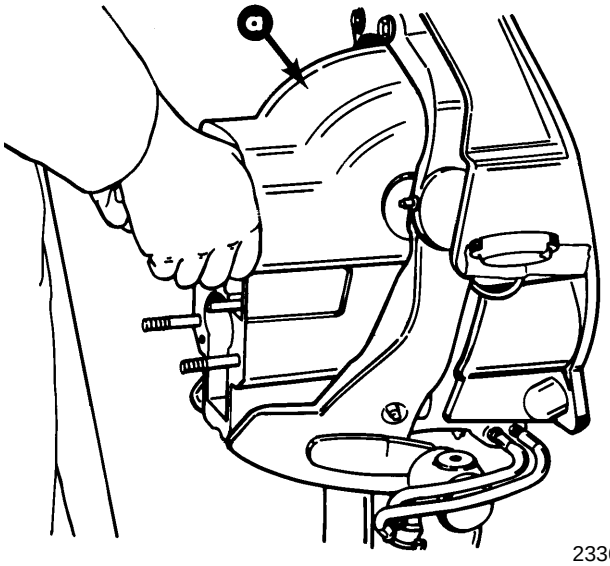
Bell Housing Installation

1. Prepare U-joint bellows for installation as follows:
   a. Clean gimbal housing mounting flange with sandpaper and wipe clean with lacquer thinner.
   b. Apply bellows adhesive to mounting surface on inside of bellows.
   c. Position grounding clip and hose clamp over bellows end.

⚠ WARNING

Be sure to read and follow package label directions when using bellows adhesive.

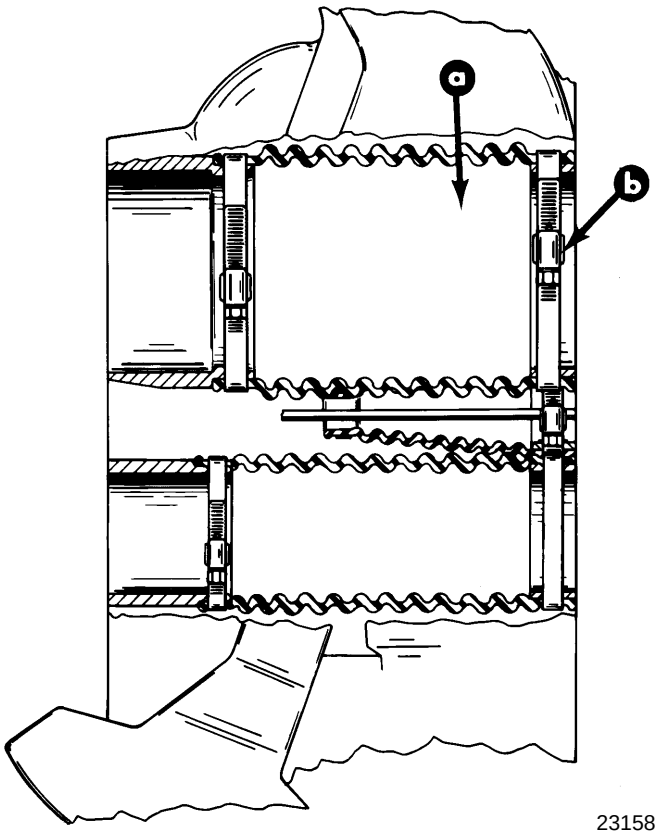
2. Install bell housing between gimbal ring. Push on bell housing and guide U-joint bellows onto gimbal housing mounting flange.



23363

a - Bell Housing

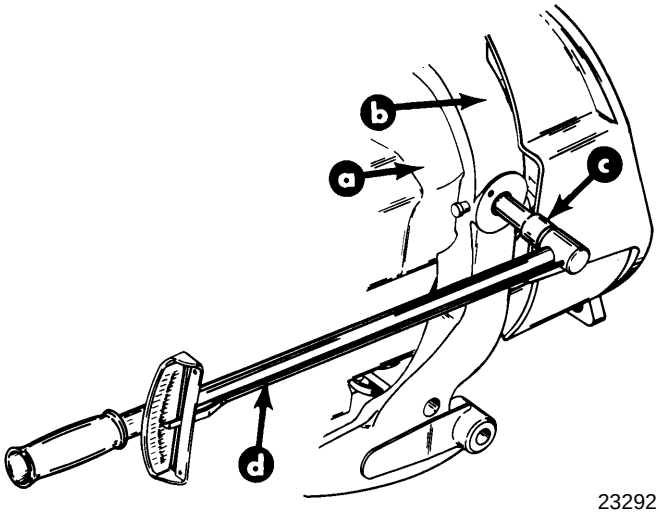
3. Position U-joint bellows hose clamp as shown and tighten securely.



23158

a - U-joint Bellows
b - Hose Clamp

4. Apply Locquic Primer “T” to hinge pin threads and allow to dry. Apply Loctite No. 35 to threads. Install hinge pins and torque to 95 lb. ft. (129 N·m).



23292

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (P/N 91-78310)
d - Torque Wrench (lb. ft.)

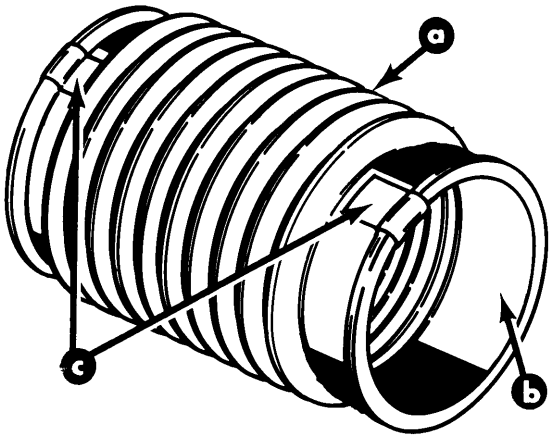
5. Install exhaust bellows on bell housing as follows:

   a. Clean bell housing mounting flange with sandpaper and wipe clean with lacquer thinner.

   b. Apply bellows adhesive to mounting surface on inside of bellows.

   c. Position grounding clip on bellows.

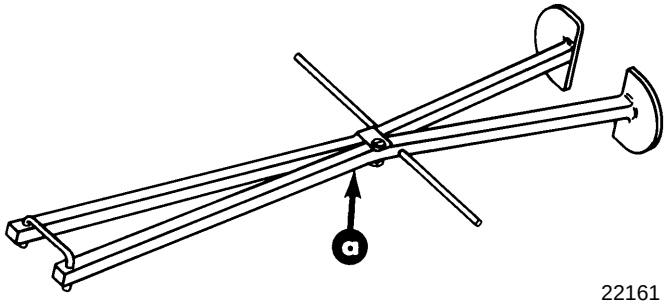
   d. Place hose clamp over bellows end.



22079

a - Exhaust Bellows
b - Mounting Surface
c - Ground Clip

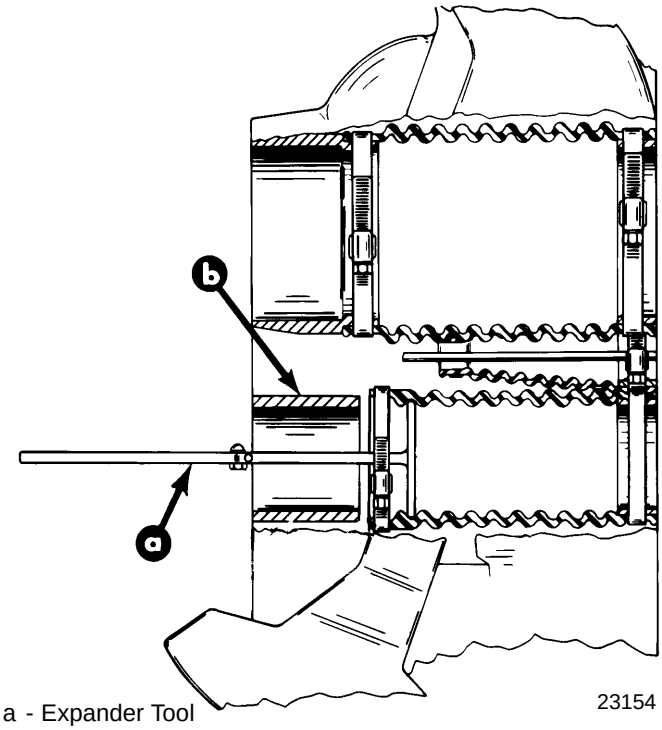
   e. Place expander tool (91-45497A1) into first bellows convolution.



22161

a - Expander Tool

   f. Pull tool until tool touches the mounting flange on bell housing (bellows starts to slip onto flange). Release tool.



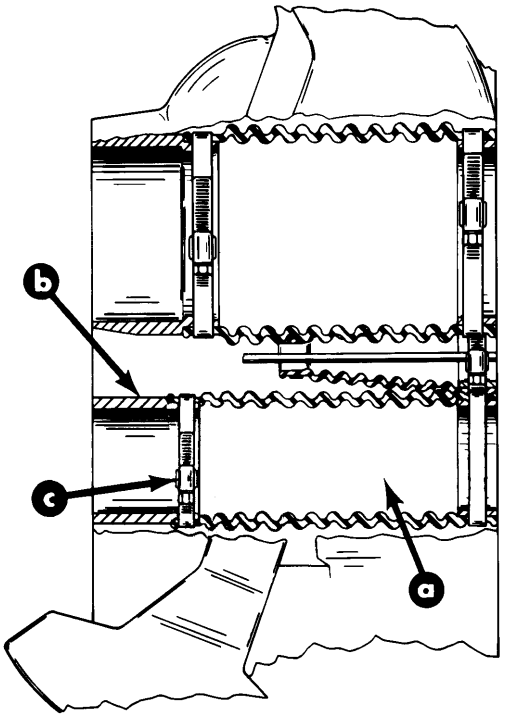
23154

a - Expander Tool
b - Bell Housing Flange

   g. Reposition tool into the third bellows convolution.

   h. Pull bellows onto bell housing flange.

i. Position hose clamp as shown and tighten securely. Remove tool.

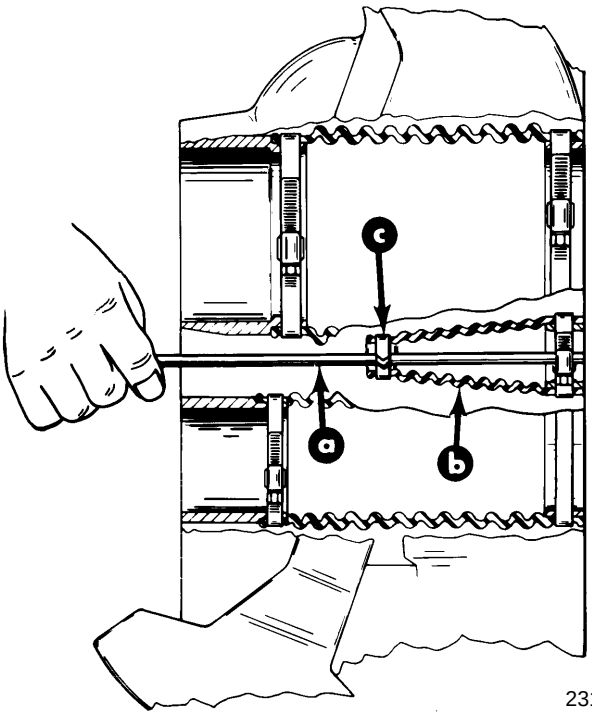


23158

a - Exhaust Bellows
b - Bell Housing Flange
c - Hose Clamp

IMPORTANT: Ensure shift cable bellows crimp clamp is not flattened out when compressing in the following step. Crimp clamp must be compressed evenly around bellows and shift cable to prevent water leakage.

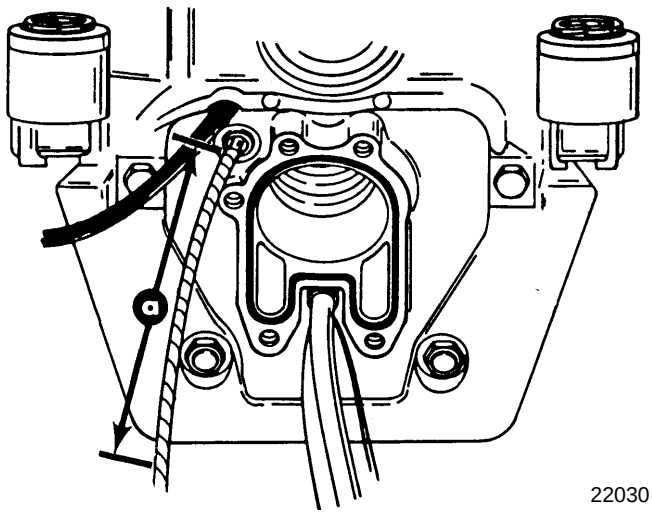
6. Insert shift cable through shift cable bellows and compress crimp clamp.



23155

a - Shift Cable
b - Shift Cable Bellows
c - Crimp Clamp

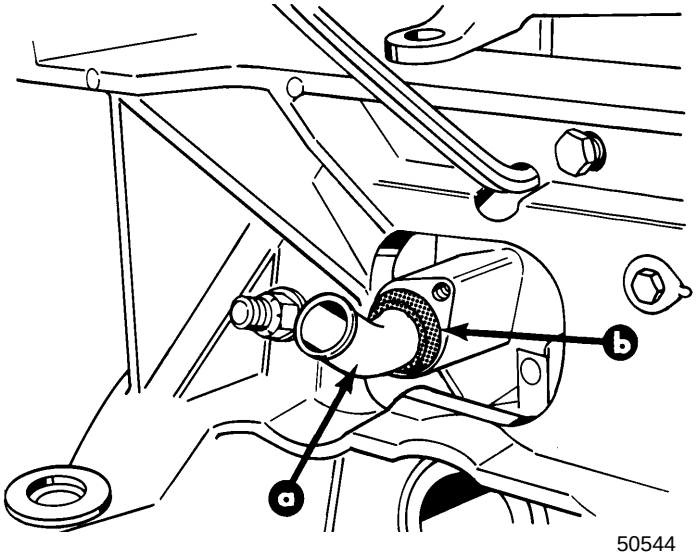
7. Install shift cable wrapping on shift cable from inner transom.



22030

a - Shift Cable Wrapping

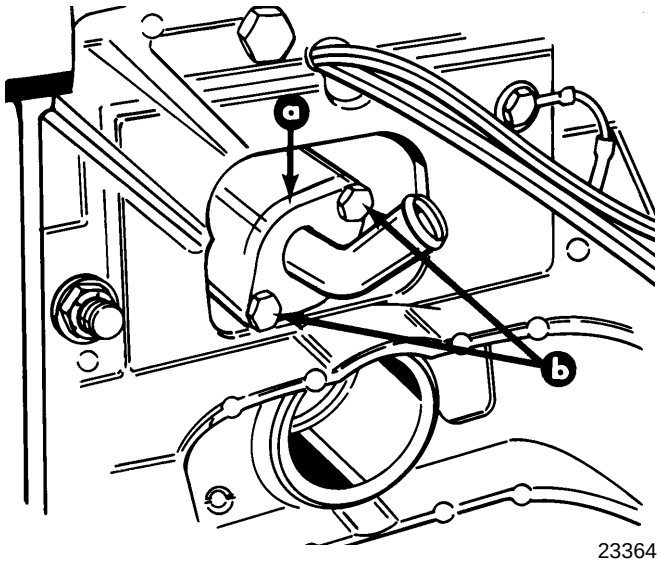
8. Install water tube through gimbal housing and install rubber grommet over tube. Push grommet into cavity.



50544

a - Water Tube
b - Rubber Grommet

9. Install water tube cover and tighten screws securely.



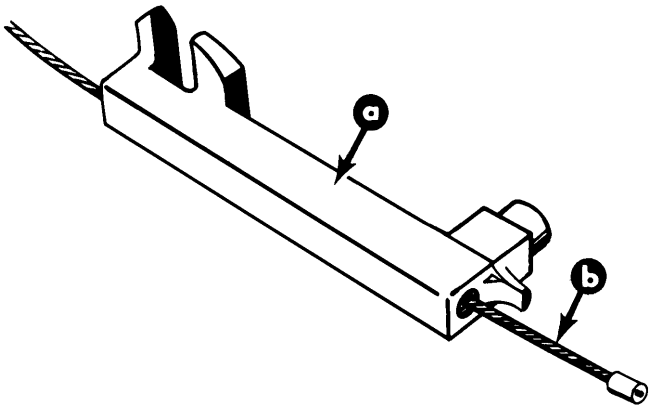
23364

a - Water Tube Cover
b - Screws

10. Install core wire through shift slide.

⚠CAUTION

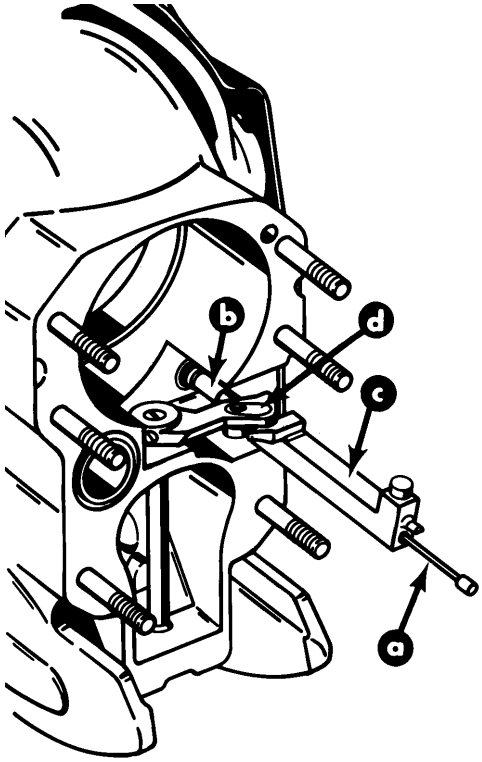
Refer to "Special Information" in the front of this section for special notes on different style shift cables.



23262

a - Core Wire
b - Shift Slide

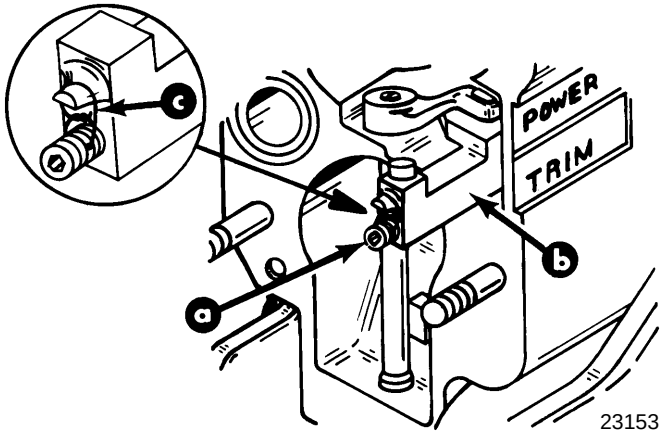
11. Install inner core wire through shift cable. Be sure and position shift lever roller between slot on shift slide.



23262

a - Inner Core Wire
b - Shift Cable
c - Shift Slide
d - Shift Lever

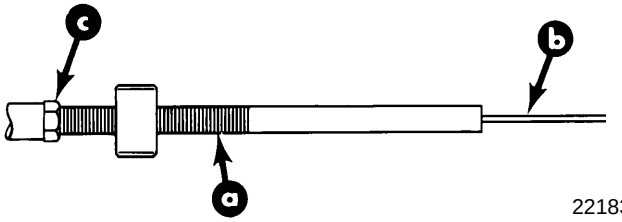
12. Install set screw. Tighten until contact with core wire. Back off 1/8 to 1/4 turn. Safety wire set screw to shift slide, using a figure 8 pattern.



23153

a - Set Screw
b - Shift Slide
c - Safety Wire

13. Install threaded tube until it bottoms; tighten finger tight only. Secure jam nut.



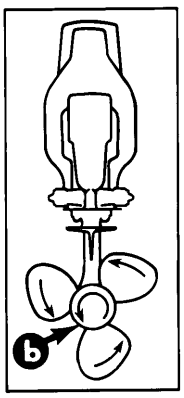
22183

a - Threaded Tube
b - Core Wire
c - Jam Nut

14. Install sterndrive unit. (Refer to Section 2A).

15. Shift drive unit into forward gear by pushing in on core wire with a pair of pliers, while rotating propeller shaft counterclockwise. Ensure clutch is fully engaged.

22183

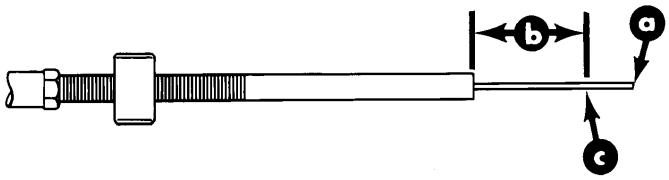


23170

a - Inner Core Wire
b - Propeller Shaft

IMPORTANT: Shift cable core wire must be measured and cut exactly as shown to ensure proper shift operation.

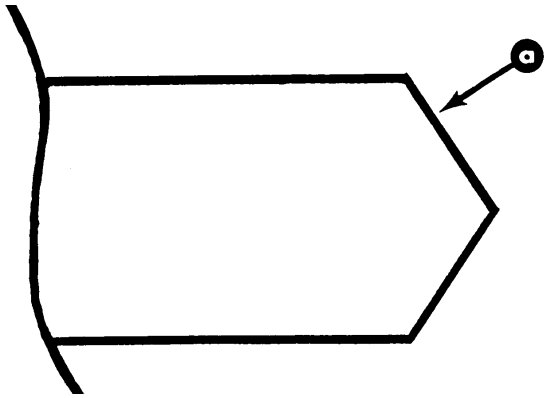
16. Measure core wire from edge of threaded tube, 1-3/8 in. (35 mm) and cut core wire at this point.



22183

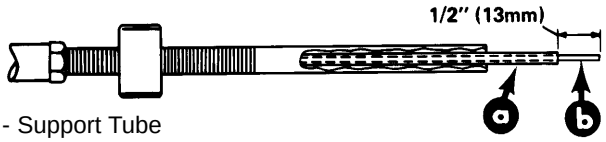
a - Core Wire
b - 1-3/8 in. (35 mm)
c - Cut Here

17. After cutting core wire to proper dimension in previous step, use a file to round off any sharp edges.



a - Core Wire Tip

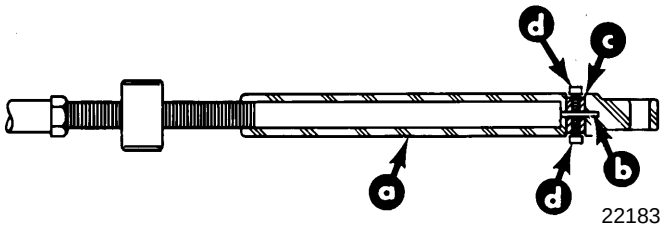
18. (If using older style shift cable that has core wire with support tube). Position support tube so that 1/2 in. (13 mm) of core wire extends from edge of support tube. Crimp end of support tube.



a - Support Tube
b - Core Wire

22183

19. Install shift cable end guide over core wire and insert core wire through cable anchor. Tighten screws securely.

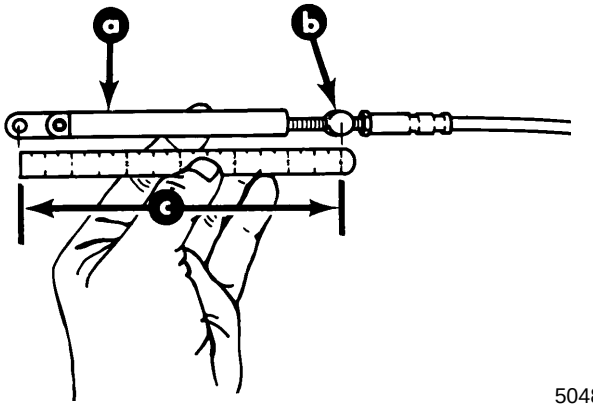


22183

a - Shift Cable End Guide
b - Core Wire
c - Cable Anchor
d - Screws (2)

20. Push in on drive unit shift cable while simultaneously turning propeller shaft counterclockwise until shaft stops, to ensure drive unit is completely in forward gear. Maintain pressure on propeller shaft with a suitable device (elastic strap).

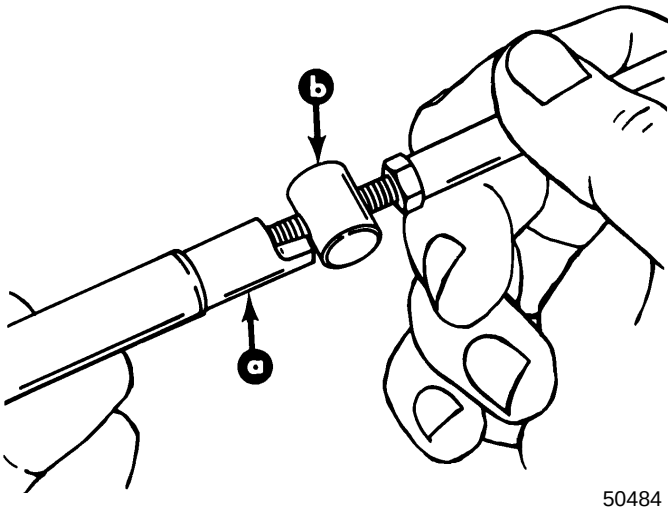
21. Measure distance between center of hole in shift cable end guide and center of brass barrel. Measurement should be 6 in. (153 mm). Turn brass barrel in direction necessary to obtain this dimension.



50484

a - End Guide
b - Brass Barrel
c - 6 in. (153 mm)

22. If old shift cable was equipped with an end guide stop clip, remove clip from old shift cable. Once brass barrel adjustment is correct, install end guide stop clip on threaded tube. Position as shown, with tang touching brass barrel.



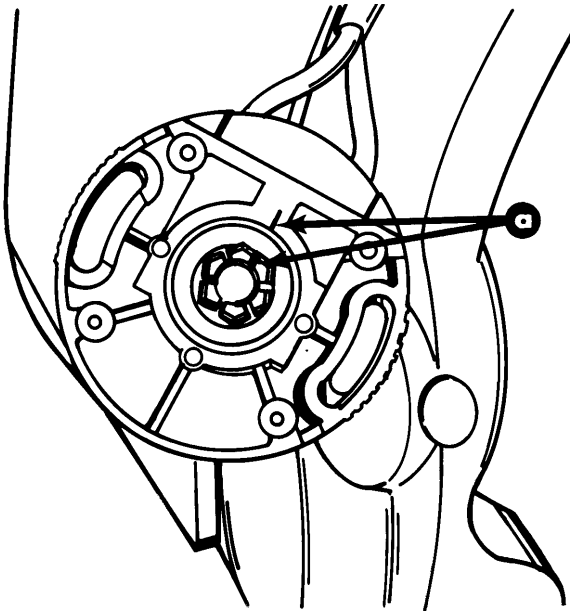
50484

a - Stop Clip
b - Brass Barrel

23. Connect shift cable to shift plate and adjust. (Refer to Section 2A).

24. Install trim limit switch as follows:

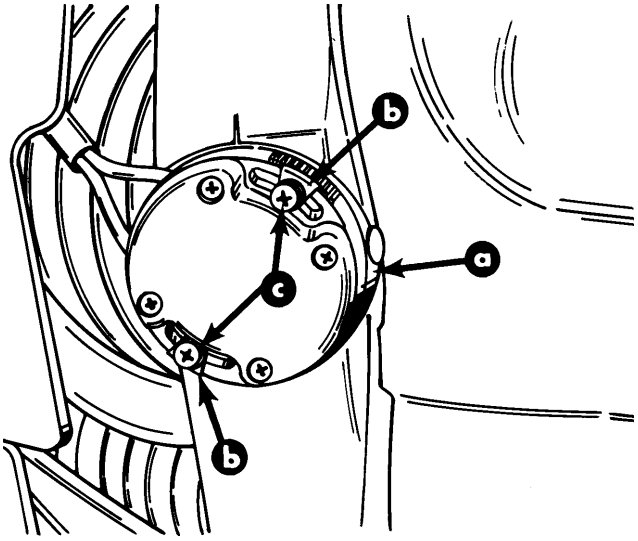
a. Align index marks on switch.



22092

a - Index Marks

b. Install trim limit switch.

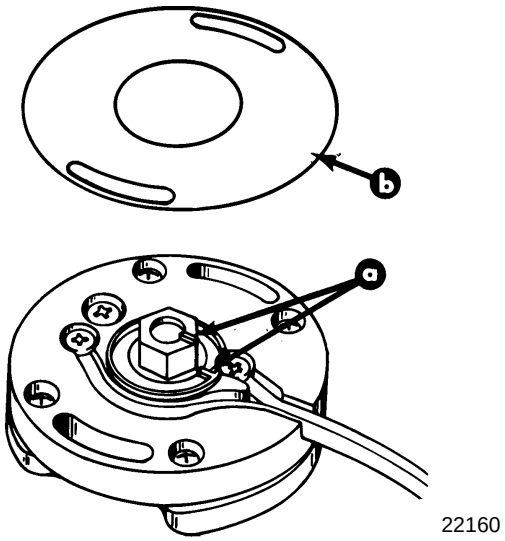


22091

a - Trim Limit Switch
b - Retainers (2)
c - Screws (2)

25. Adjust trim limit switch (Refer to Section 4A).

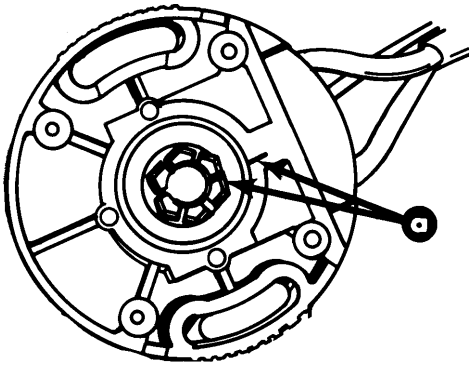
26. Install trim position sender as follows:
    a. **Models with older style sender,** install insulator.
    b. Align index marks.



22160

Older Style Sender

a - Index Marks
b - Insulator

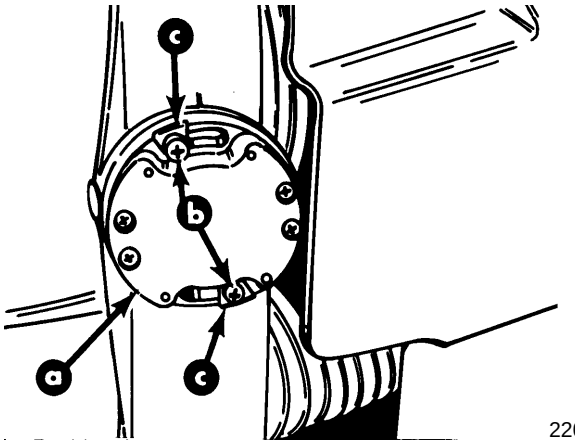


22092

Newer Style Sender

a - Index Marks

    c. Install trim position sender. Ensure insulator slots align with slot in sender.

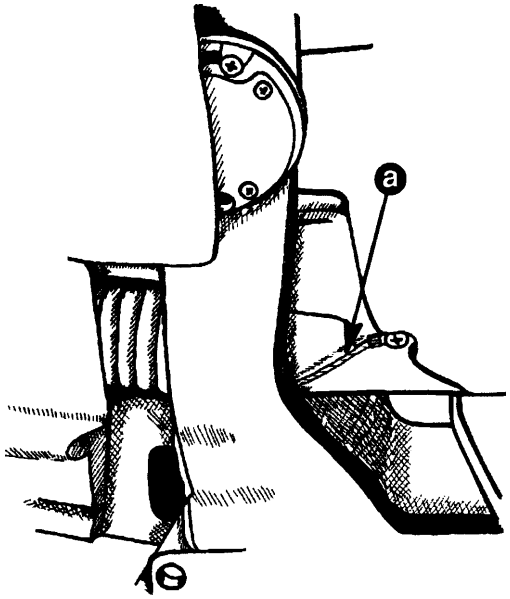


22091

a - Trim Position Sender
b - Screws (2)
c - Retainer (2)

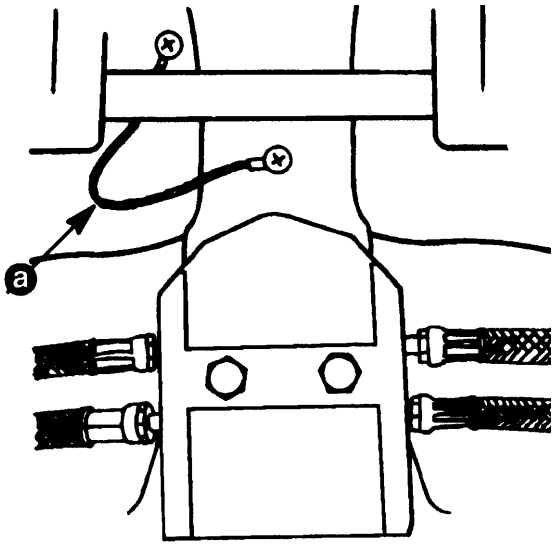
27. Adjust trim position sender (Refer to Section 4A).

28. Connect continuity wire to port side of bell housing.



22755

a - Port Side Continuity Wire



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a - Continuity Wire

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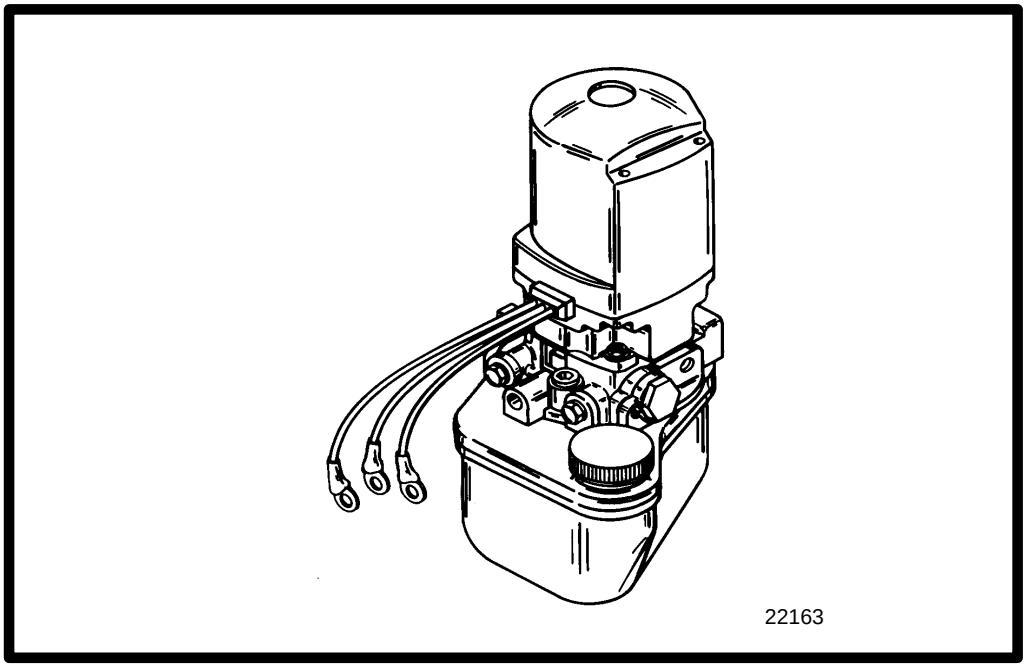
POWER TRIM



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A

OILDYNE POWER TRIM PUMP (WITH PLASTIC RESERVOIR)

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Specifications

Valve Pressure Specifications

Valve	Pressure
Up Circuit	2200-2600 psi (15173-17932 kPa)
Down Circuit	400-600 P.S.I. (2759-4138 kPa)

Electrical Specification

Pump Amperage Draw	115 Amps at 2200-2600 P.S.I. (15173-17932 kPa)

Torque Specification

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Up Pressure Relief Valve	70		7.9
Down Pressure Relief Valve	70		7.9
Thermal Relief Valve	70		7.9
Pump to Adaptor Mounting Screws	70		7.9
Motor to Adaptor Mounting Screws	25		2.8
Reservoir Screw	10-15		1.2-1.6
Hex Plug Retainers	38-50		51-67
Up Pressure Hydraulic Hose (Black)	70-150		7.9-16.9
Down Pressure Hydraulic Hose (Gray)	70-150		7.9-16.9

Special Tools

Description	Part No.
Test Gauge Kit	91-52915A6
Multi-Meter	91-99750
Torque Wrench (lb. in.)	91-66274
Hex Lobular Socket (Torx Socket)	Obtain Locally
Jumper Wire	Obtain Locally

Lubricants/Adhesives/ Sealers

Description	Part No.
Power Trim and Steering Fluid	92-90100A12
2-4-C Marine Lubricant	92-825407A2
Liquid Neoprene	92-25711-2

Maintaining Power Trim Pump Oil Level

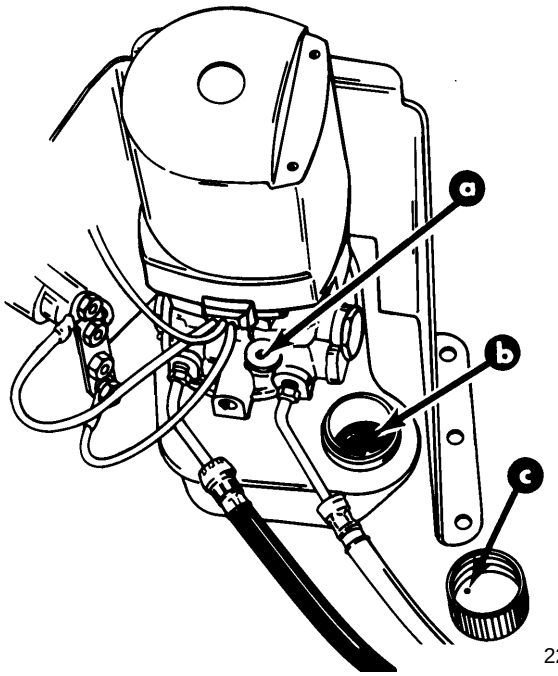
⚠CAUTION

Vent screw, if equipped, MUST BE backed out two (2) full turns (after bottoming out) to vent pump reservoir. FAILURE TO BACK SCREW OUT COULD RESULT IN DAMAGE TO PUMP. Units without vent screw: fill cap is vented. Check that "Caplug" (fill neck seal) is removed.

IMPORTANT: Check oil level with sterndrive unit in the full down position.

IMPORTANT: SAE 10W-30 or 10W-40 engine oil can be used in system, if Quicksilver Power Trim and steering fluid is not available.

1. Remove fill cap, then raise and lower drive unit 6 to 10 times to purge air from system. Check oil level visually (b).



22031

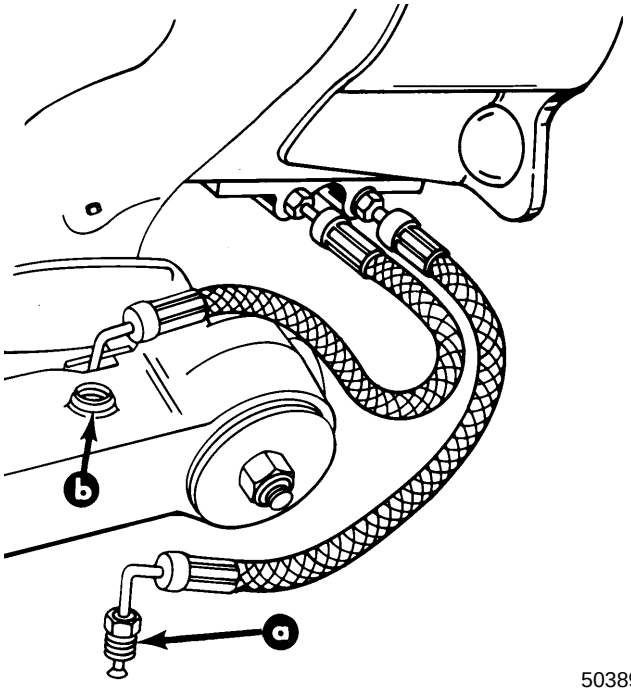
a - If There Is A Vent Screw, It Must Be Backed Out 2 Full Turns; If There Is No Vent Screw, The Fill Cap Is Vented If "Caplug" (Fill Neck Seal) Is Removed
b - Oil Level Should Be Maintained Between The "Max." And "Min." Marks On The Side Of The Reservoir. When Adding Oil, Fill To Bottom Lip On The Fill Neck, As Shown
c - Vent Hole

Air Bleeding Power Trim System

The Power Trim System will purge itself of a small amount of air by raising and lowering the drive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the following bleeding procedure should be used to remove the air from the system.

Bleeding OUT/UP Trim Circuit

1. Fill pump reservoir to proper level as explained preceding. (Trim cylinder must be compressed.)
2. Disconnect OUT/UP hose from front connection on trim cylinder. If both cylinders were rebuilt, disconnect hoses from both cylinders.
3. Direct end of trim hose(s) into a container.
4. Run trim pump in the UP direction until a solid, air-free stream of fluid is expelled from hose(s). Reconnect hose(s) and tighten securely.
5. Refill trim pump to proper level.

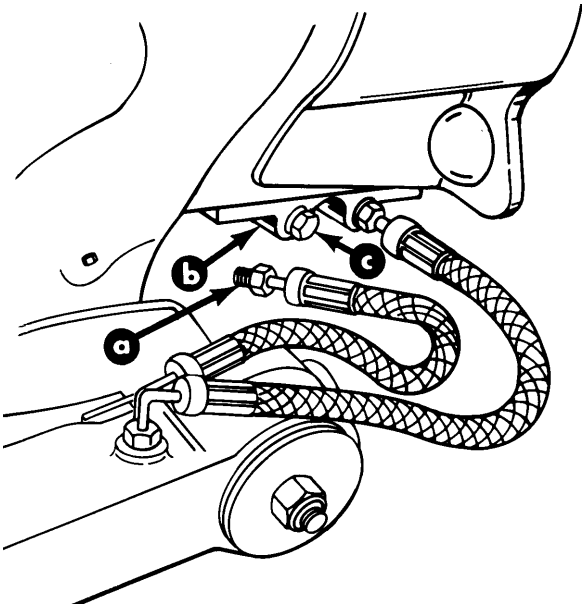


50389

a - OUT/UP Trim Hose
b - Front Connection On Trim Cylinder

Bleeding IN/DOWN Trim Circuit

1. Ensure pump reservoir is filled to proper level.
2. Disconnect IN/DOWN hose from rear connection on gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect hoses from both sides of hydraulic connector.
3. Plug holes in hydraulic connector, using plug (22-38609) or suitable device.
4. Direct end of trim hose(s) into container.
5. Run trim pump in the UP direction until trim cylinders are fully extended.
6. Remove plug(s) from gimbal housing hydraulic connector and momentarily run trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from rear hole(s) in hydraulic connector. Reconnect trim hose(s) and tighten securely.
7. Lower drive unit to the full IN/DOWN position and refill trim pump to proper level. Run trim system IN/DOWN and OUT/UP several times and re-check fluid level.



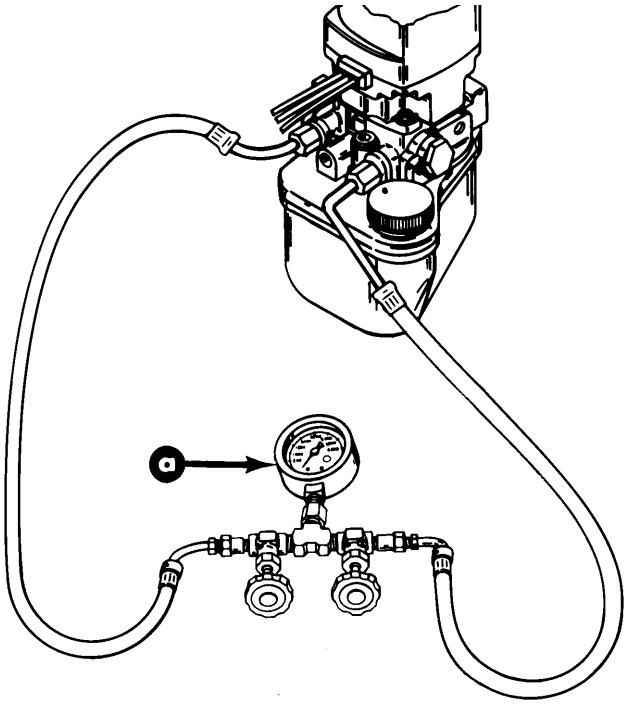
50389

a - IN/DOWN Trim Hose
b - Hydraulic Connector
c - Plug (22-38609)

Testing Power Trim Pump

Connecting Test Gauge

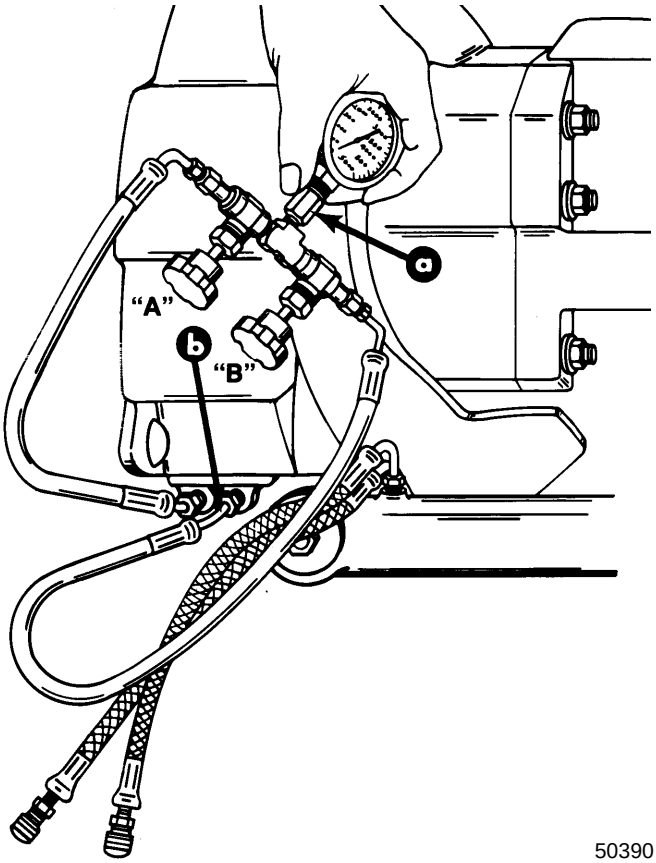
1. Check trim pump oil level. Fill if necessary.
2. Place drive unit in the full IN/DOWN position.
3. Connect test gauge at the most convenient location (at pump or hydraulic connector):



22124

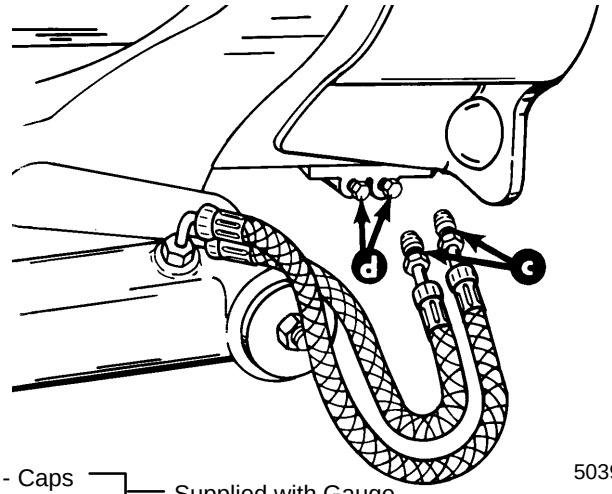
Gauge Connected to Pump

a - Hydraulic Test Gauge (91-52915A6)



50390

a - Hydraulic Test Gauge (91-52915A6)
b - Gimbal Housing Hydraulic Connector



50391

c - Caps
d - Plugs
Supplied with Gauge

Gauge Connect to Hydraulic Connector

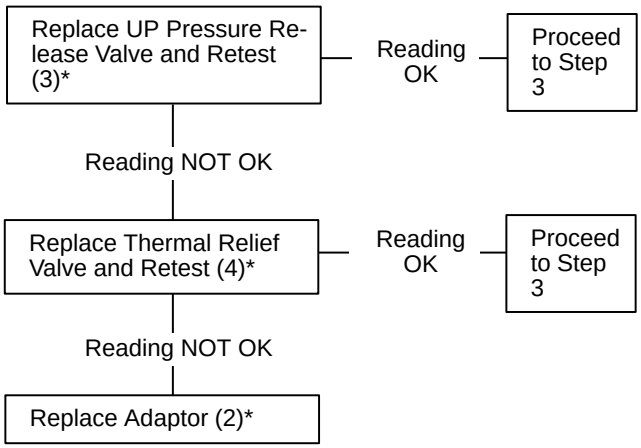
4. Open Valve "A" and "B" and run pump UP and DOWN several times (to purge air).

Internal Restriction Test

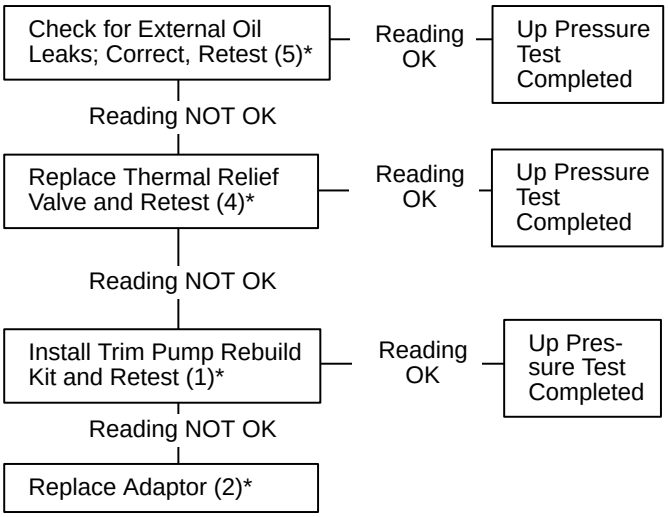
1. Open valve "A" and "B."
2. Run pump OUT/UP and IN/DOWN while observing gauge.
3. Replace adaptor, if pressure is in excess of 200 psi (1379 kPa).

OUT/UP Pressure Test

1. Leave Valve "A" open and close Valve "B".
2. Run pump OUT/UP while observing gauge. Reading should be 2200-2600 psi (15173-17932 kPa).
   - **Gauge reading within specifications,** proceed to step 3.
   - **Gauge reading not within specifications,** perform the following:


Replace UP Pressure Release Valve and Retest (3)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Thermal Relief Valve and Retest (4)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Adaptor (2)*

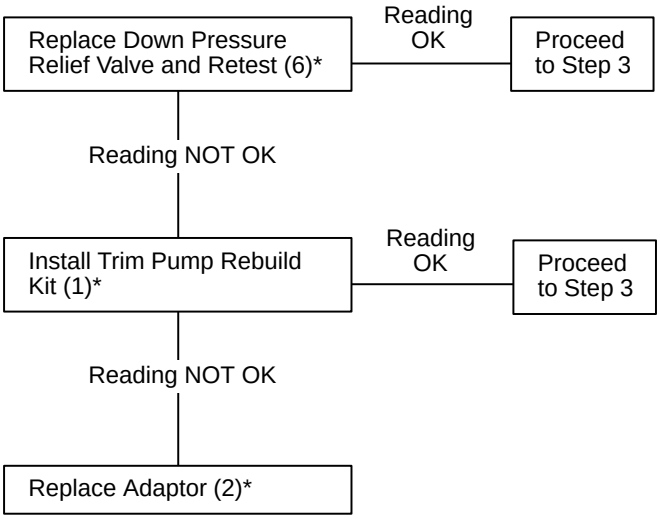
3. Run pump OUT/UP until gauge reading reaches 2200-2600 psi (15173-17932 kPa). Stop pumping UP. Pressure should not fall below 1900 psi (13104 kPa).
   - Gauge reading NOT below 1900 psi (13104 kPa). UP Pressure Test completed.
   - Gauge reading below 1900 psi (13104 kPa), perform the following:


Check for External Oil Leaks; Correct, Retest (5)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Thermal Relief Valve and Retest (4)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Install Trim Pump Rebuild Kit and Retest (1)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Adaptor (2)*

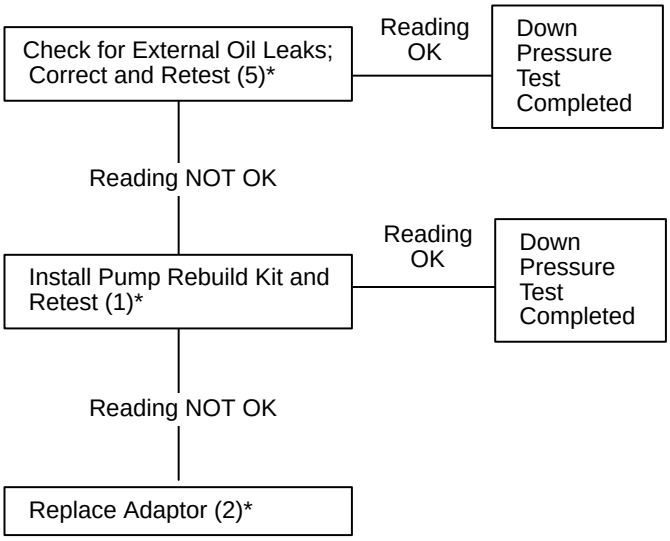
* The callout numbers refer to the Trim Pump Hydraulic System drawing on p. 5A-5.

IN/DOWN Pressure Test

1. Close Valve “A” and open Valve “B”.
2. Run pump IN/DOWN while observing gauge. Reading should be 400-600 psi (2759-4138 kPa).
   - Gauge reading within specifications, proceed to step 3.
   - Gauge reading NOT within specifications, perform the following.



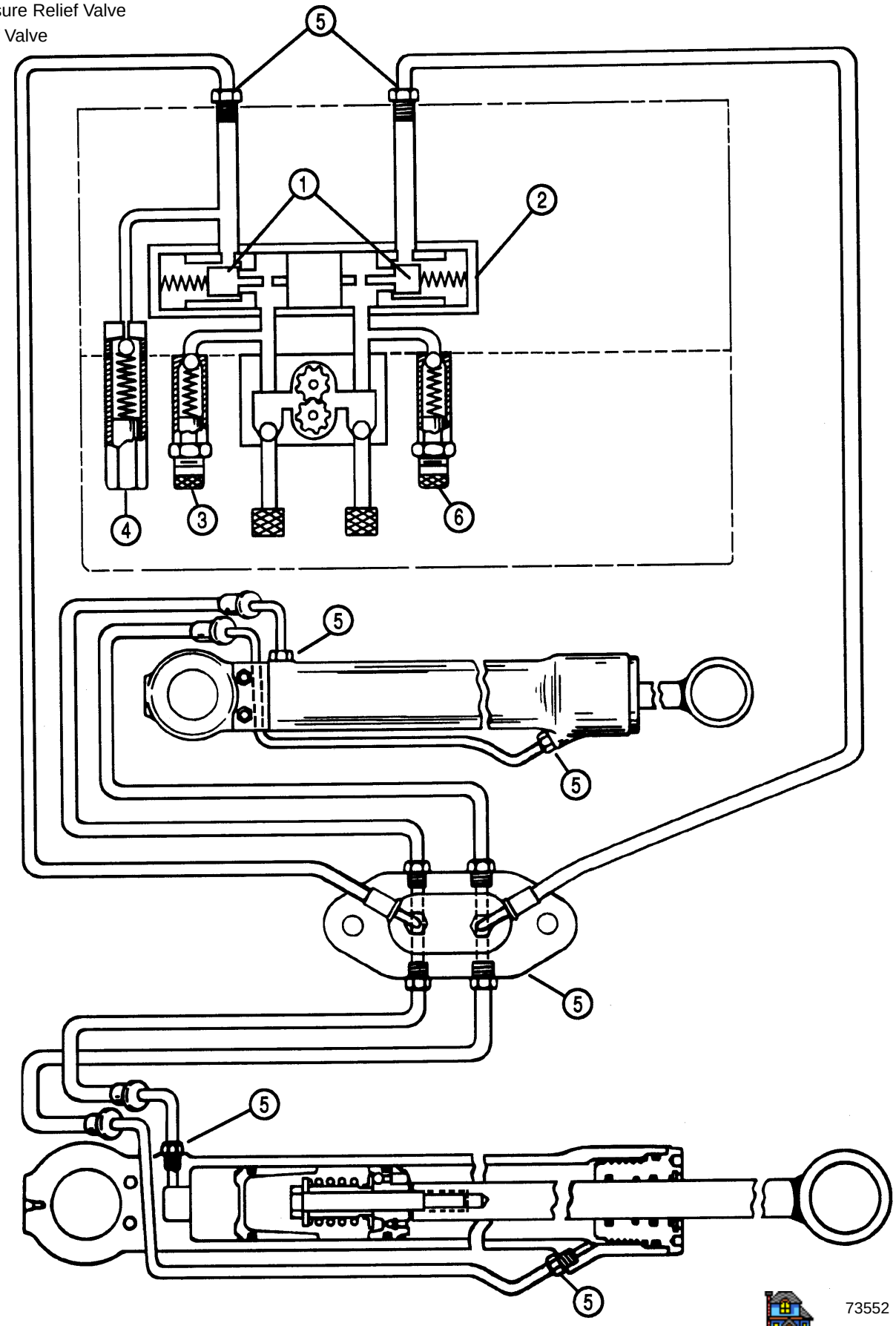
3. Run pump IN/DOWN until gauge reading reaches 400-600 psi (2759-4138 kPa). Stop pumping IN/DOWN. Pressure should not fall below 350 psi (2414 kPa).
   - Gauge reading above 350 psi (2414 kPa), DOWN Pressure Test completed.
   - Gauge reading below 350 psi (2414 kPa), perform the following:


Check for External Oil Leaks; Correct and Retest (5)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Install Pump Rebuild Kit and Retest (1)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Replace Adaptor (2)*

* The callout numbers refer to the Trim Pump Hydraulic System drawing on p. 5A-5.

Trim Pump Hydraulic System

1 - Shuttle
2 - Pump Adaptor
3 - UP/OUT Pressure Relief Valve
4 - Thermal Relief Valve
5 - Fitting
6 - IN/DOWN Pressure Relief Valve



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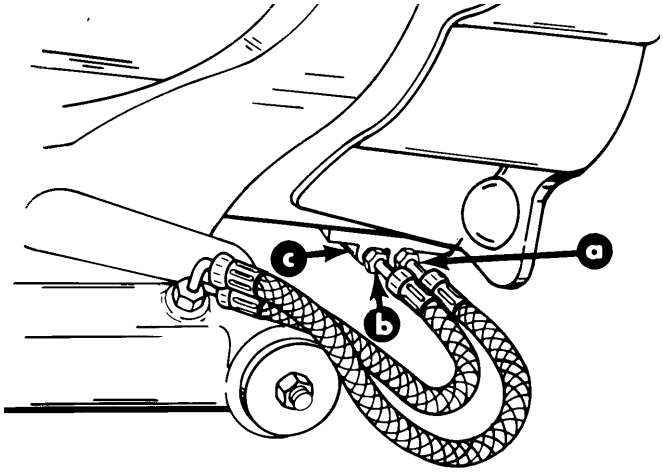
Trim Cylinder Internal Leak Test

IMPORTANT: The following test assumes that pump OUT/UP pressure is within specifications as determined by performing "Power Trim Pump Test".

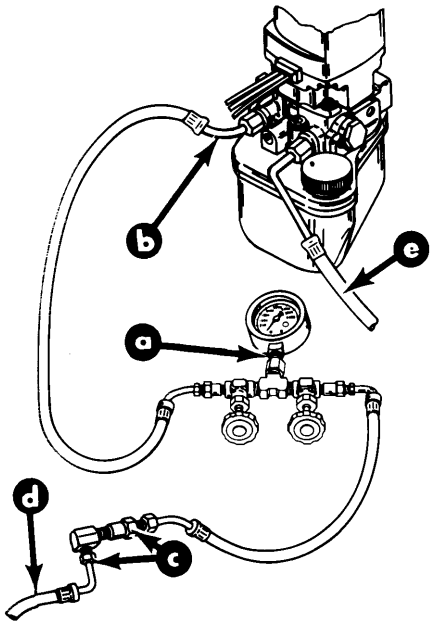
1. Reconnect trim cylinder hoses (if removed in previous test) as follows:
   a. Remove plugs and caps.
   b. Install UP hose to forward hole on hydraulic connector. Tighten securely.
   c. Install DOWN hose to aft hole on hydraulic connector. Tighten securely.



50391

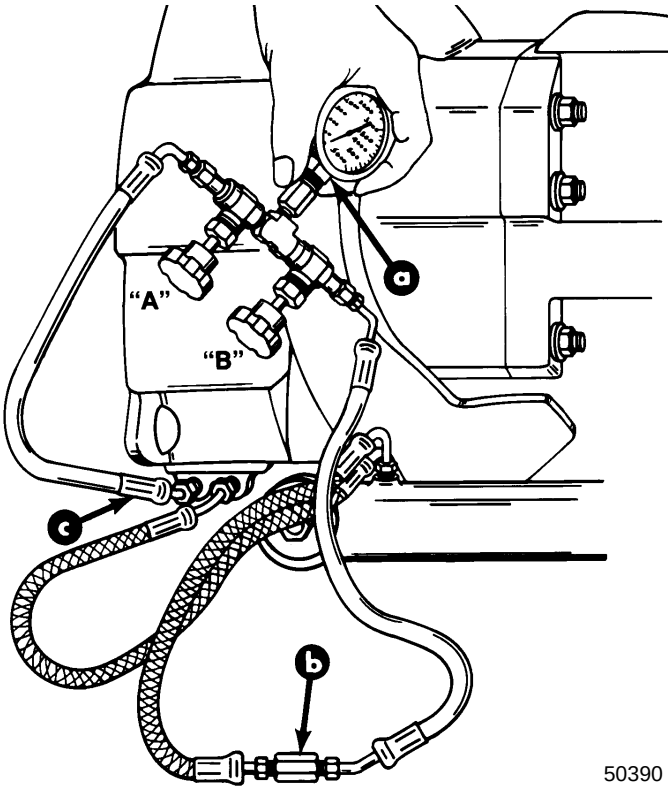
a - UP Hose
b - DOWN Hose
c - Hydraulic Connector

2. Connect gauge at most convenient location.



22125

a - Hydraulic Test Gauge
b - Hose Connected To UP (Left Hole)
c - Fittings-(Supplied With Gauge)
d - Black Hose (From Gimbal Housing)
e - Grey Hose (From Gimbal Housing)



50390

Gauge Connected to Hydraulic Connector

a - Test Gauge
b - Coupling (Supplied With Gauge)
c - Front Hydraulic Connector Port

3. Open Valve "A" and "B" and run pump OUT/UP and IN/DOWN several times (to purge air).
4. Run pump OUT/UP until trim cylinders are fully extended; then, observe gauge while pumping. Pressure should be 2200-2600 psi (15173-17932 kPa).
5. Stop pumping OUT/UP. Pressure should not fall below 1900 psi (13104 kPa).

   If readings are not within specifications, an internal trim cylinder leak is indicated. Use the following procedure to locate faulty cylinder.

   a. If gauge is connected at pump, reconnect gauge at gimbal housing hydraulic connector. Repeat Step 2; then, run pump in OUT/UP direction until trim cylinder is fully extended.

   b. Close Valve "B" on test gauge and repeat Steps 3 and 4.

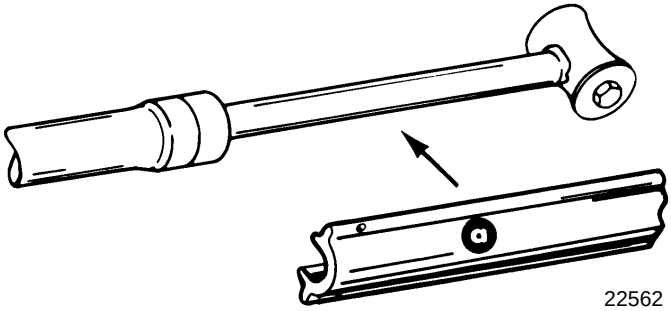
   If readings are now within specifications: Trim cylinder on the same side that test gauge is connected is faulty.

   If readings are still not within specifications: Trim cylinder on the opposite side from where the test gauge is connected is faulty.

Trim Cylinder Shock Piston Test

If trim system checks out good, but drive unit will not trim IN/DOWN, problem may be due to a leaky trim cylinder shock piston. Use the following test to check for this condition. Test gauge is not required.

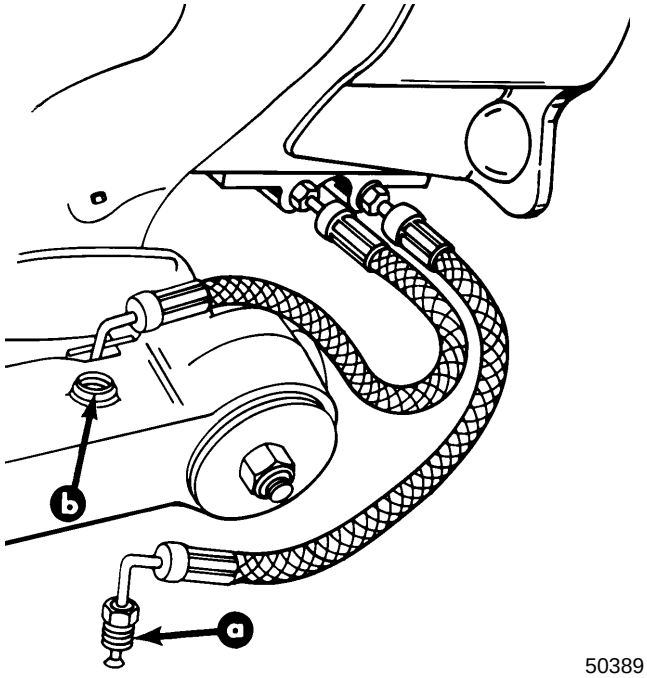
1. Run pump in OUT/UP direction until trim cylinders are fully extended.
2. Prevent trim cylinder piston rods from retracting, using a suitable device. Quicksilver Trailering Kit works well for this purpose.



22562

a - Trailering Clip

3. Disconnect UP trim hose from trim cylinders.



50389

a - UP Trim Hose
b - Front Connection

4. Run pump in IN/DOWN direction. If oil flows from UP port on trim cylinder, shock piston is leaking and must be replaced.

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Motor and Electrical Bench Tests

Trim Pump Motor Test (In Boat)

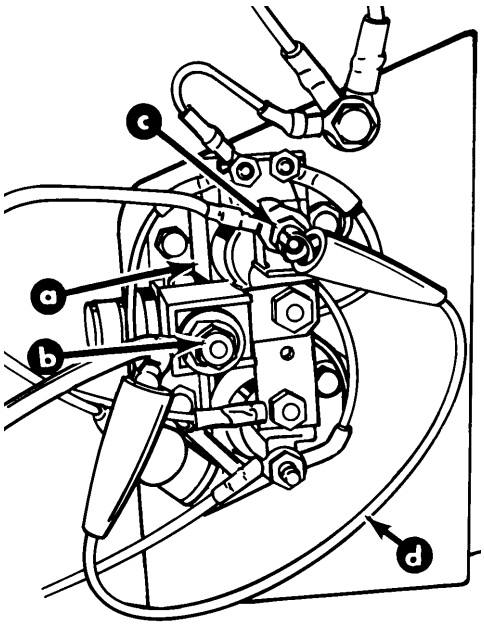
⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

⚠WARNING

Remain clear of drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

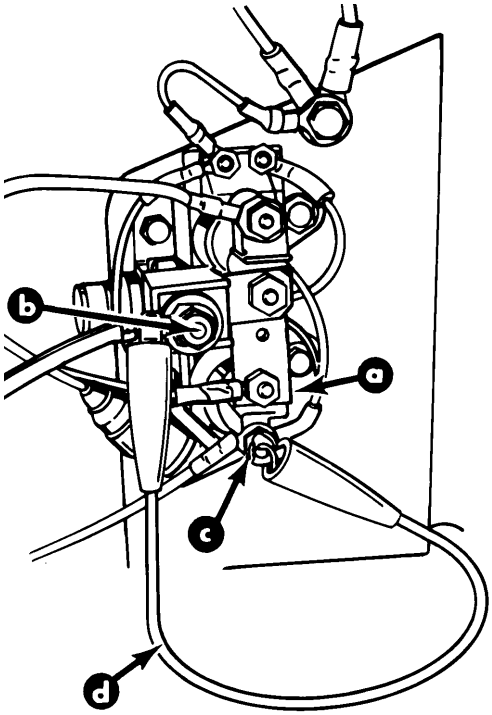
1. OUT/UP Operation.
   a. Connect a jumper wire between positive (+) solenoid terminal and BLUE/WHITE motor lead terminal.
   b. Motor should run.



22494

a - OUT/UP Solenoid
b - Positive Terminal (+)
c - BLUE/WHITE Motor Lead Terminal
d - Jumper Wire

2. IN/DOWN Operation.
   a. Connect a jumper wire between positive (+) solenoid terminal and GREEN/WHITE motor lead terminal.
   b. Motor should run.



22495

a - IN/DOWN Solenoid
b - Positive Terminal (+)
c - GREEN/WHITE Motor Lead Terminal
d - Jumper Wire

3. If motor does not run, refer to “Motor Repair.” See Table of Contents.

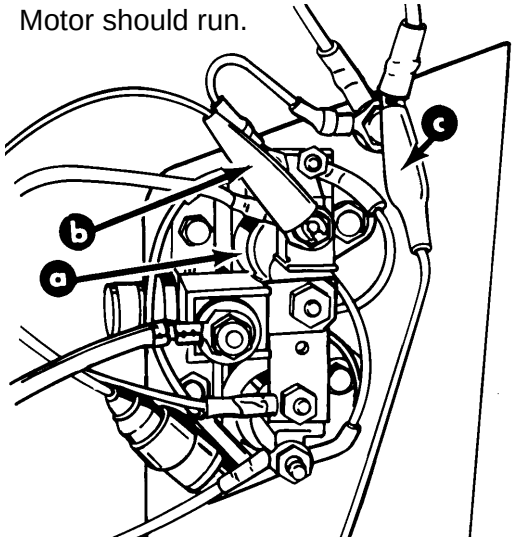
Trim Pump Motor Test (Out of Boat)

⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

1. Remove trim pump from boat. Refer to “Trim Pump Removal.” See Table of Contents.
2. Remove fluid from trim pump reservoir.

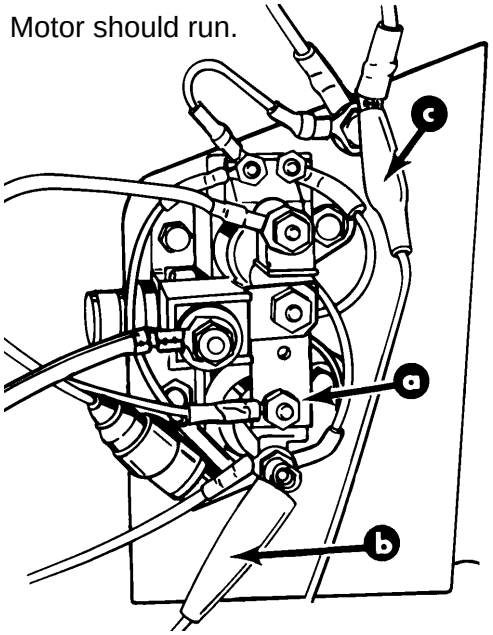
3. OUT/UP Operation.
   a. Connect a 12 volt positive (+) supply lead to BLUE/WHITE motor lead terminal.
   b. Connect the negative (-) supply lead to a good ground on pump.
   c. Motor should run.



22495

a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead

4. IN/DOWN Operation.
   a. Connect a 12 volt positive (+) supply lead to GREEN/WHITE motor lead terminal.
   b. Connect the negative (-) supply lead to a good ground on pump.
   c. Motor should run.



22494

a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead

5. If motor does not run, refer to “Motor Repair”. See Table of Contents.

Solenoid Test (Pump in Boat)

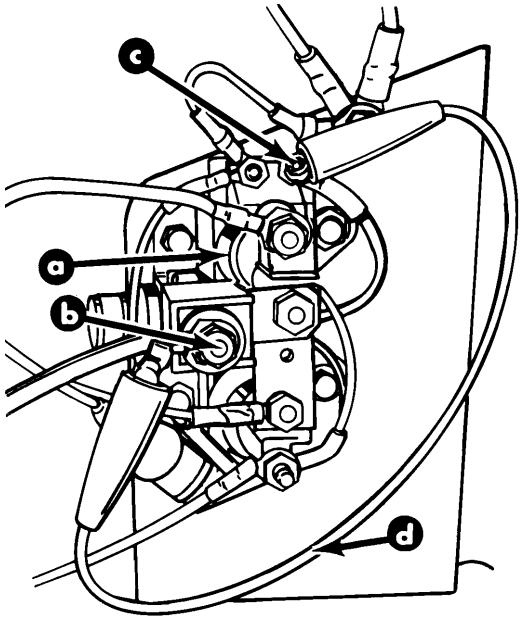
⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

⚠CAUTION

Remain clear of drive unit when performing power trim pump motor tests with pump in boat and hydraulic hose connected.

1. UP/OUT Solenoid.
   a. Connect jumper wire between positive (+) solenoid terminal and BLUE/WHITE harness wire terminal.
   b. Motor should run.



22495

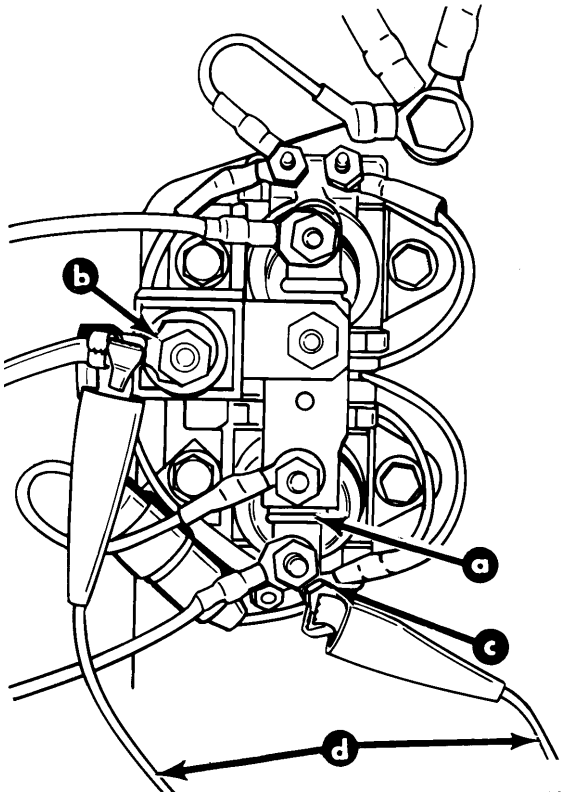
a - OUT/UP Solenoid
b - Positive (+) Solenoid Terminal
c - BLUE/WHITE Harness Wire Terminal
d - Jumper Wire

Index

2. IN/DOWN Solenoid.

   a. Connect a jumper wire between positive (+) solenoid terminal and GREEN/WHITE harness wire terminal.

   b. Motor should run.



22494

a - IN/DOWN Solenoid
b - Positive (+) Solenoid Terminal
c - GREEN/WHITE Harness Wire Terminal
d - Jumper Wire

3. If motor does not run in one direction or another, replace appropriate solenoid. (See Wiring Diagram at end of this section for wire connection points).

Solenoid Test (Pump Out of Boat)

⚠WARNING

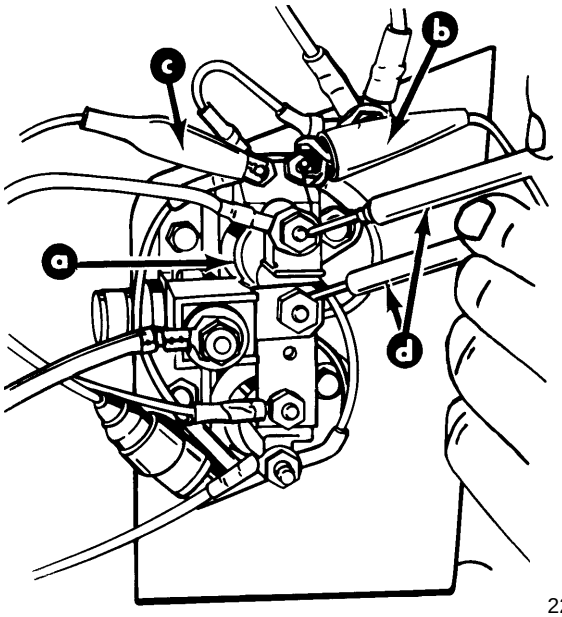
DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

1. Remove trim pump from boat. Refer to “Trim Pump Removal”. See Table of Contents.
2. Remove fluid from trim pump reservoir.
3. OUT/UP Solenoid.

   a. Connect 12 volt positive (+) supply lead to BLUE/WHITE harness wire terminal.

   b. Connect negative (-) supply lead to solenoid ground terminal.

   c. Connect ohmmeter leads to large terminals on solenoid.



22493

a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead
d - Ohmmeter Leads

4. **Zero Ohms Reading** (Full Continuity)-Solenoid is ok.

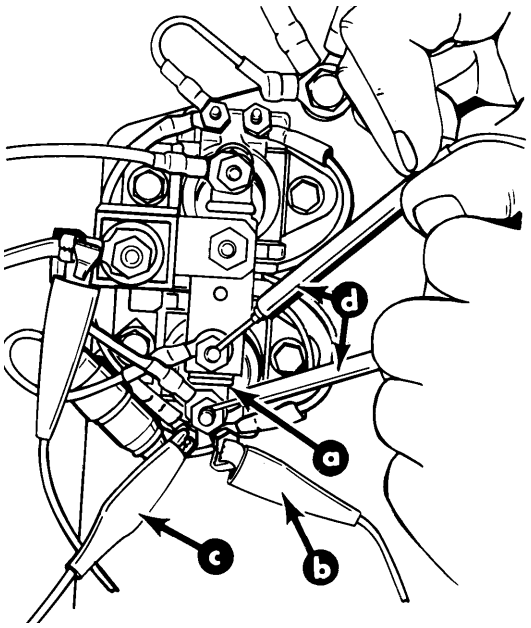
   High Ohms Reading (No Continuity)-Replace solenoid.

5. IN/DOWN Solenoid.

   a. Connect 12 volt positive (+) supply lead to GREEN/WHITE harness wire terminal.

   b. Connect negative (-) supply lead to solenoid ground terminal.

   c. Connect ohmmeter leads to large terminals on solenoid.



22494

a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead
d - Ohmmeter Leads

6. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.

   High Ohms Reading (No Continuity)-Replace solenoid.

See Wiring Diagram at the end of this section for wiring connection points.

110 Amp Fuse Test (Pump in Boat)

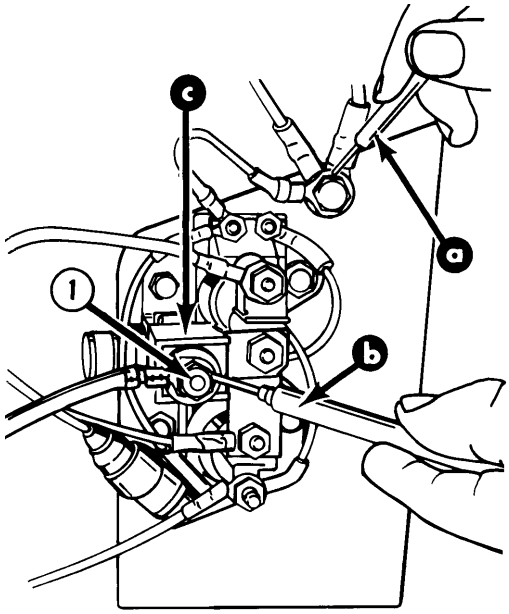
⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

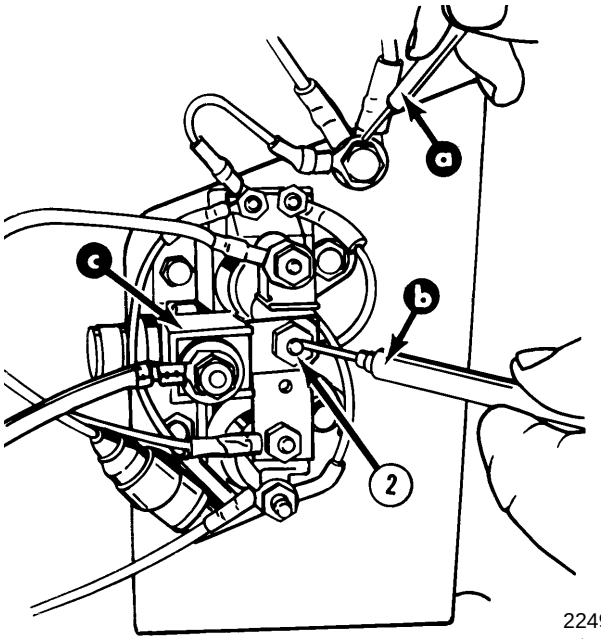
1. Check for voltage at terminal “1” using a volt meter. Voltage MUST BE indicated before proceeding with next check.
2. Check for voltage at terminal “2,” using volt meter.

Voltage Indicated: Fuse OK

Voltage Not Indicated: Replace fuse



22495



22493

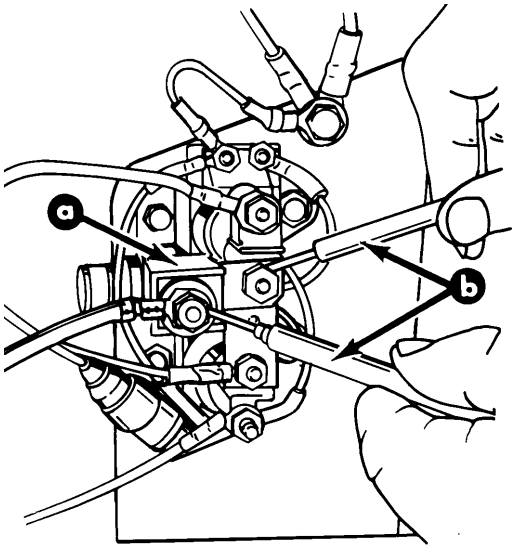
a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse

110 Amp Fuse Test (Pump Out of Boat)

1. Connect ohmmeter leads between terminals on fuse.

Zero Ohms Reading (Full Continuity)-Fuse OK

High Ohms Reading (No Continuity)-Replace fuse

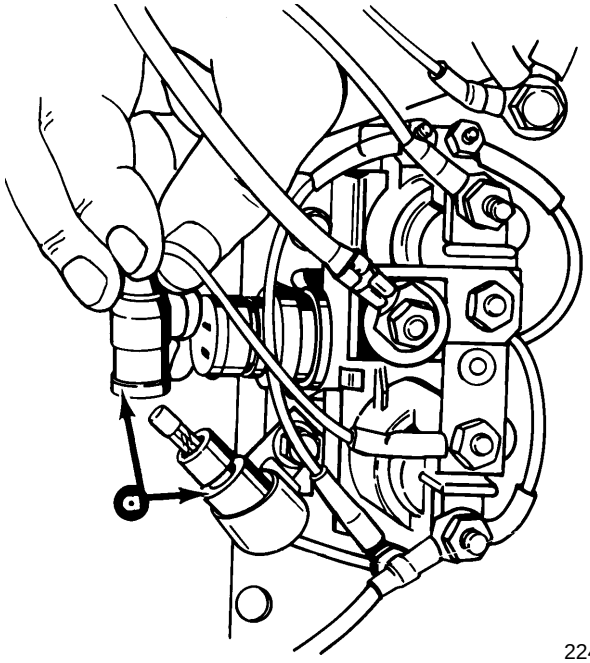


22493

a - 110 Amp Fuse
b - Ohmmeter Leads

20 Amp Fuse Test

1. Remove fuse from fuse holder.



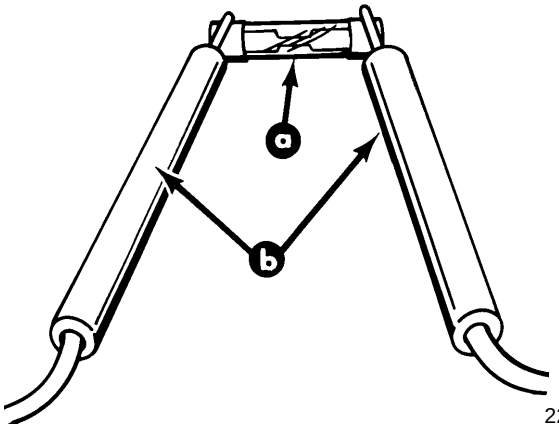
22496

a - Fuse Holder

2. Connect ohmmeter; one lead to each end of fuse.

Zero Ohms Reading (Full Continuity)-Fuse OK

High Ohms Reading (No Continuity)-Replace fuse

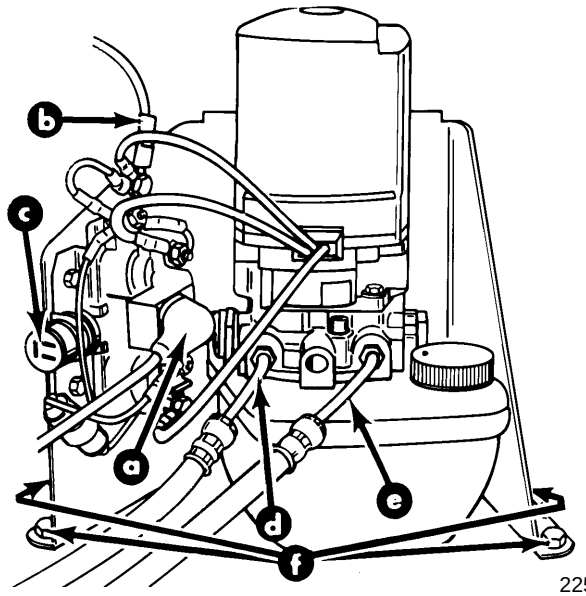


22497

a - 20 Amp Fuse
b - Ohmmeter Leads

Trim Pump Removal

1. Disconnect trim pump battery leads from battery (negative lead first).
2. Disconnect trim harness connector (3 pronged) from trim pump.
3. Remove hydraulic hoses from trim pump. Cap end of hoses.
4. Remove lag bolts and washers. Lift pump and floor bracket from boat.



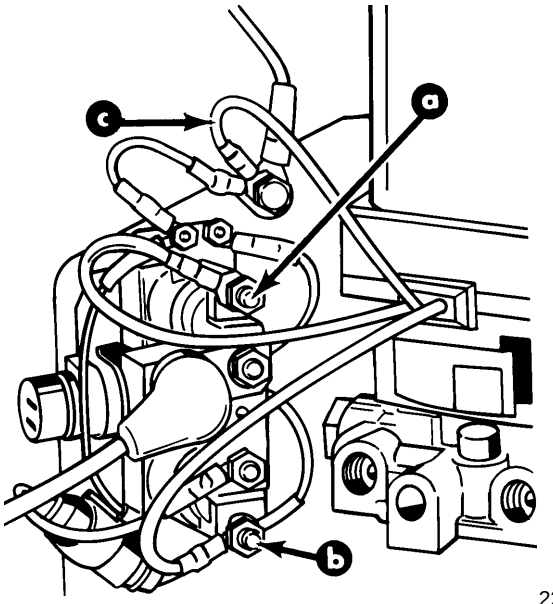
22549

a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)
f - Lag Bolts and Washers

Hydraulic Repair

Disassembly

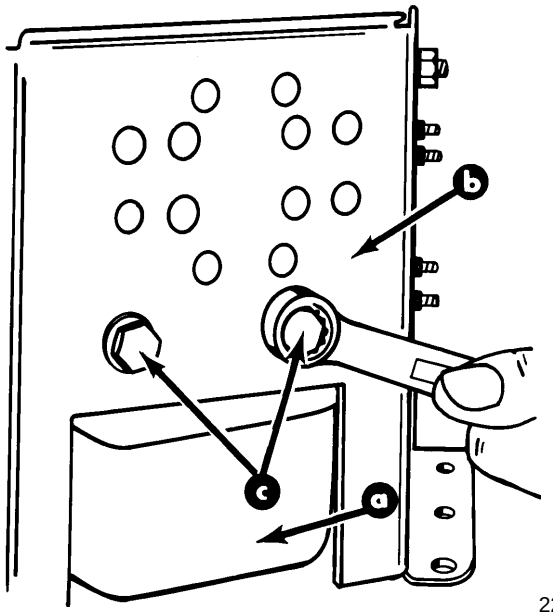
1. Disconnect trim motor wires.



22497

a - Blue/White Motor Wire
b - Green/White Motor Wire
c - Black Ground Wire

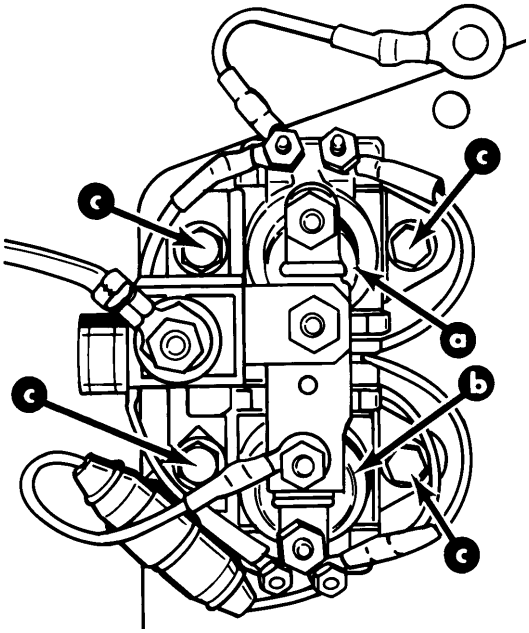
2. Remove mounting bolts and remove trim pump from floor bracket.



22548

a - Trim Pump
b - Floor Bracket
c - Mounting Bolts

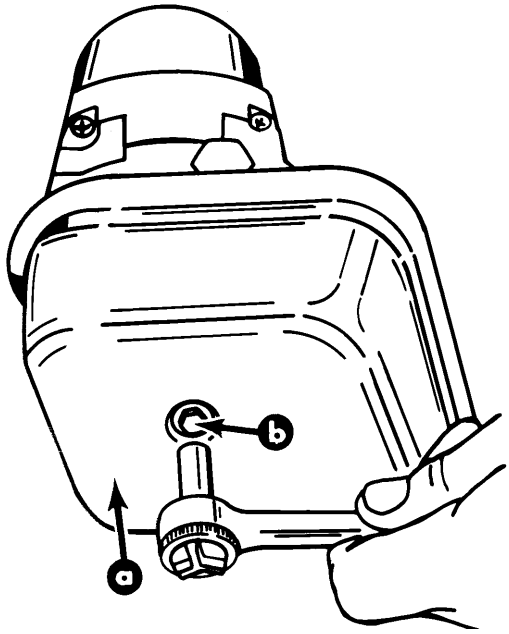
3. Remove solenoids (if replacement is necessary).



22496

a - UP Solenoid
b - DOWN Solenoid
c - Mounting Bolts (2 On Each Solenoid)

4. Remove pump reservoir.

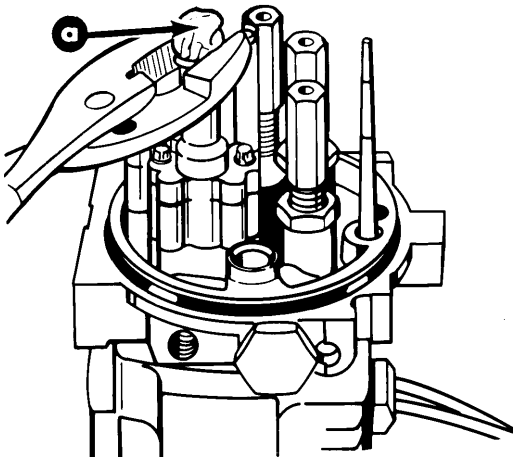


22547

a - Pump Reservoir
b - Bolt And O-ring-Spacer

Filter Replacement

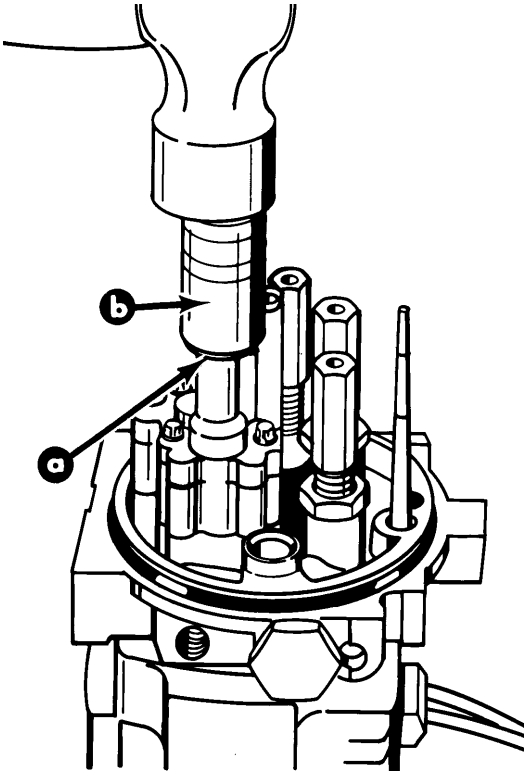
1. Remove filter by twisting while pulling upward.



22547

a - Filter

2. Install new filter.



22547

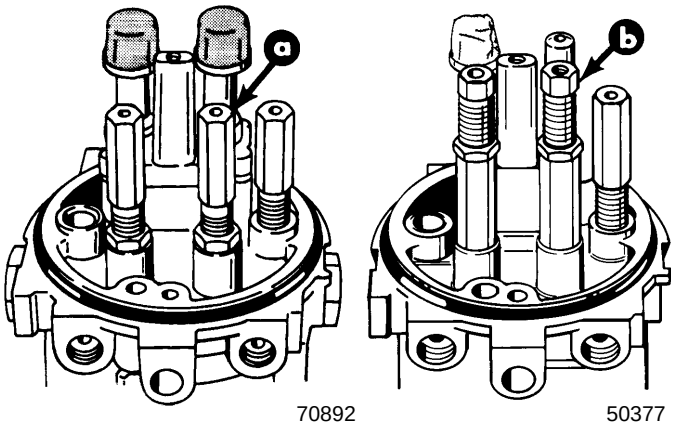
a - Filter
b - 5/8 in. Socket

UP Pressure Relief Valve Replacement

NOTE: *UP pressure relief valve in kit is color coded blue for easy identification.*

IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen nor attempt to remove hex "jam" nut. This valve is preset at the factory for proper UP pressure relief.

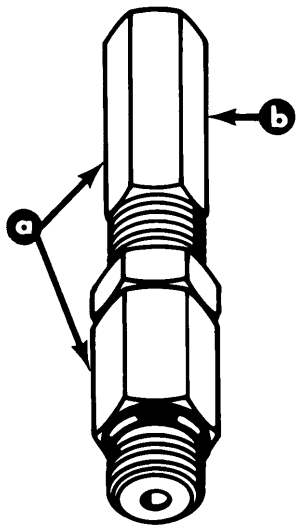


70892 50377

a - Factory Installed UP Pressure Relief Valve
b - Earlier Style Replacement Pressure Relief Valve

NOTE: *Original factory installed pressure relief valves will be a natural steel finish-they will NOT be color coded.*

CURRENT REPLACEMENT PRESSURE RELIEF VALVE



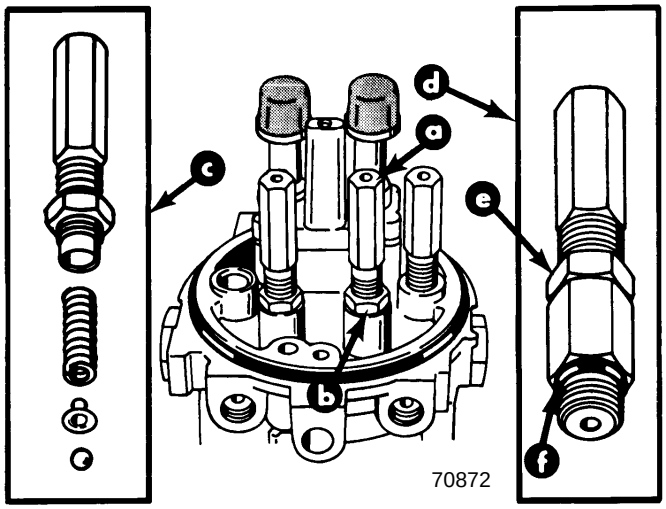
50396

a - Replacement UP Pressure Relief Valve
b - Color Coded Blue

Index

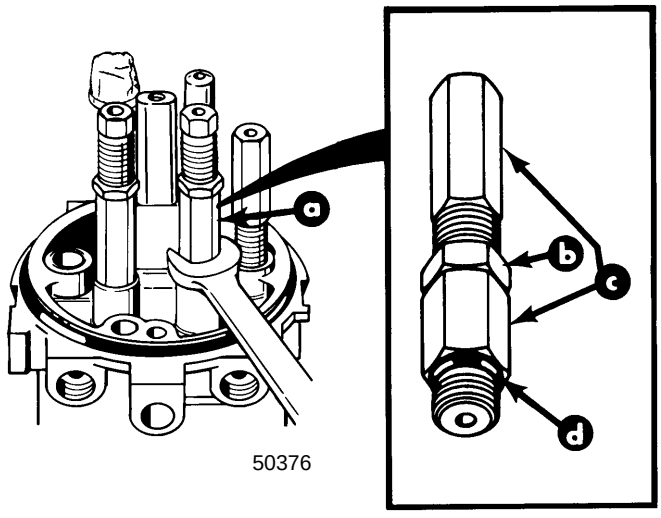
1. Replace UP pressure relief valve. Loosen jam nut on original pressure valve. Do NOT loosen jam nut on replacement valves. Remove spring, eyelet and check ball and discard. Ensure that threaded hole is free of dirt. Lubricate O-ring at base of new valves with Power Trim and Steering Fluid and install. Use base of replacement valve to tighten. Torque to 70 lb. in. (7.9 N·m).

ORIGINAL FACTORY INSTALLED PRESSURE RELIEF VALVE



a - Original Factory Installed UP Pressure Relief Valve
b - Jam Nut (a)
c - Pump Body Components (Spring, Eyelet, Check Ball)
d - Replacement UP Pressure Relief Valve (Blue)
e - Jam Nut
f - O-ring

EARLIER STYLE REPLACEMENT PRESSURE RELIEF VALVE



a - UP Pressure Relief Valve
b - Jam Nut
c - Replacement UP Pressure Relief Valve (Blue)
d - O-ring

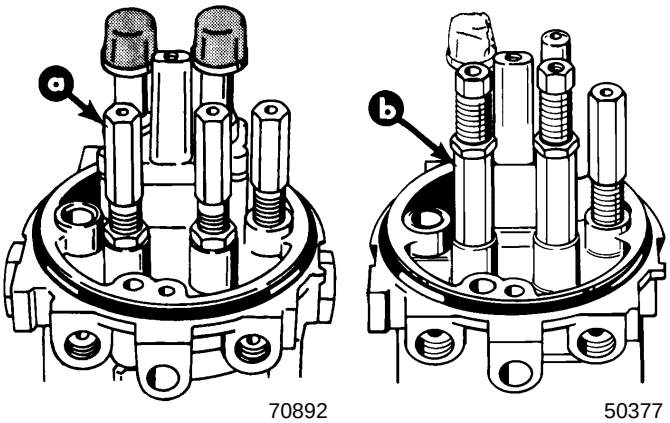
DOWN Pressure Relief Valve Replacement

NOTE: *DOWN pressure relief valve in kit is color coded green for easy identification.*

IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

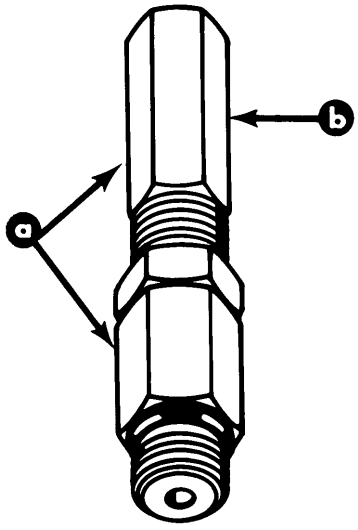
IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen nor attempt to remove hex "jam" nut. This valve is preset at the factory for proper DOWN pressure relief.

NOTE: *Original factory installed pressure relief valves will be a natural steel finish-they will NOT be color coded.*



a - Factory Installed DOWN Pressure Relief Valve
b - Earlier Style Pressure Relief Valve

CURRENT REPLACEMENT PRESSURE RELIEF VALVE

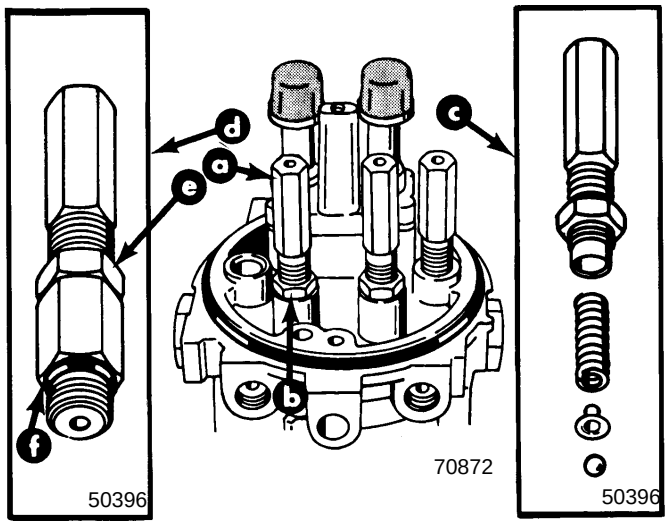


a - Replacement DOWN Pressure Relief Valve
b - Color Coded Green

Index

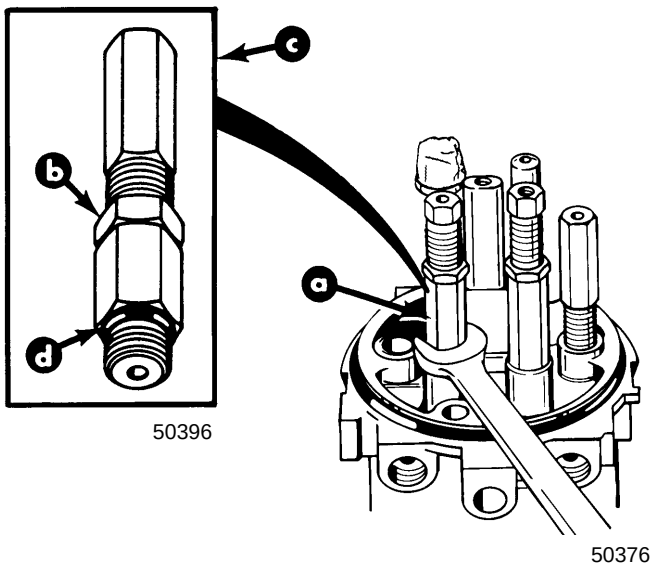
1. Replace DOWN pressure relief valve. Loosen jam nut on original pressure valve. Do NOT loosen jam nut on replacement valves. Remove spring, eyelet and check ball and discard. Ensure that threaded hole is free of dirt. Lubricate O-ring at base of new valve with Power Trim and Steering Fluid and install. Use base of replacement valve to tighten. Torque to 70 lb. in. (7.9 N·m).

ORIGINAL FACTORY INSTALLED PRESSURE RELIEF VALVE



a - Original Factory Installed DOWN Pressure Relief Valve
b - Jam Nut
c - Pump Body Components (Spring, Eyelet, Check Ball)
d - Replacement DOWN Pressure Relief Valve (Green)
e - Jam Nut
f - O-ring

EARLIER STYLE REPLACEMENT PRESSURE RELIEF VALVE



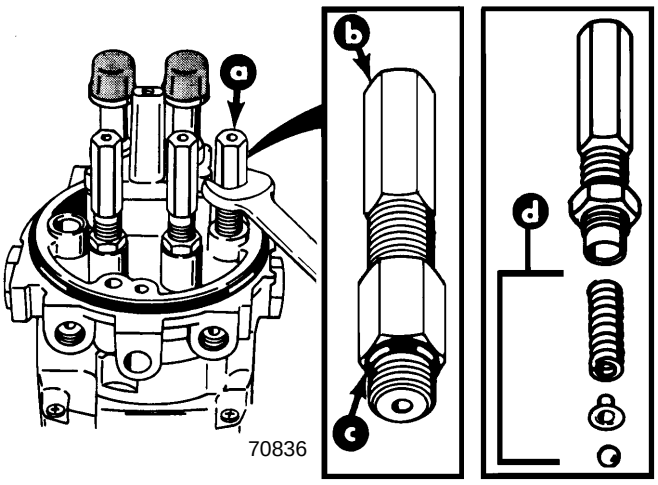
a - DOWN Pressure Relief Valve
b - Jam Nut-DO NOT TURN Or Attempt To Loosen
c - Replacement Valve (Green)-Use Base Of Valve To Tighten
d - O-ring

Thermal Relief Valve Replacement

NOTE: *Thermal Relief Valve in kit is color coded gold for easy identification.*

IMPORTANT: Thermal relief valve is factory preset. DO NOT loosen or attempt to separate component parts. Do not use wrench on upper gold colored fitting; tightening with wrench must be on the lower hex-fitting of the replacement valve.

1. Replace thermal relief valve. Remove and discard spring, eyelet and check ball on earlier style valves. Ensure that threaded hole is free of dirt. Lubricate O-ring at base of new valve with Power Trim and Steering Fluid and install. Torque to 70 lb. in. (7.9 N·m).

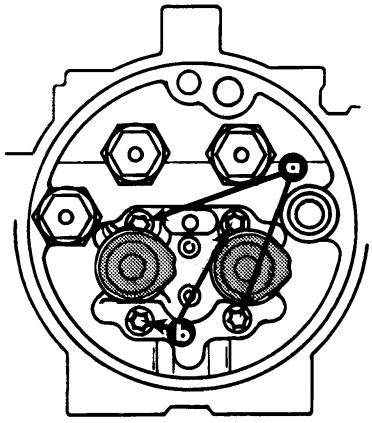


a - Thermal Relief Valve
b - Replacement Thermal Relief Valve (Gold)
c - O-ring
d - Spring, Eyelet And Check Ball On Earlier Style Valves

Pump Replacement

NOTE: *The pump is not rebuildable. If pump is defective, replace as an assembly.*

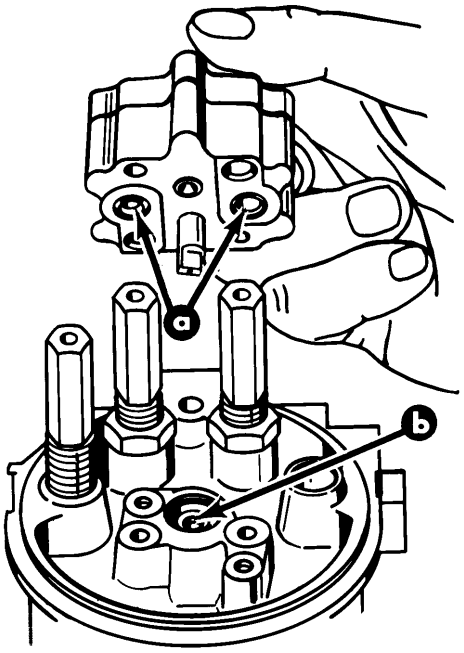
1. Remove pump attaching screws with a hex lobular socket or standard 3/16 in. socket. Do NOT loosen pinion assembly screws. Remove pump.



a - Screws
b - Pinion Assembly Screws

Index

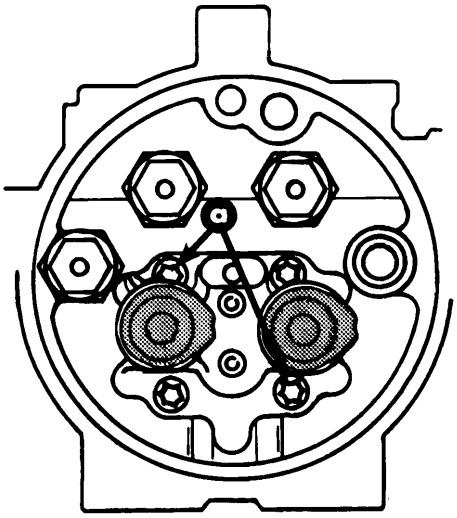
2. Remove O-rings from old pump and install on new pump.
3. Lubricate lip of adaptor seal with light weight oil.



22545

a - O-rings
b - Adaptor Seal

4. Install pump and torque screws to 70 lb. in. (7.9 N·m).

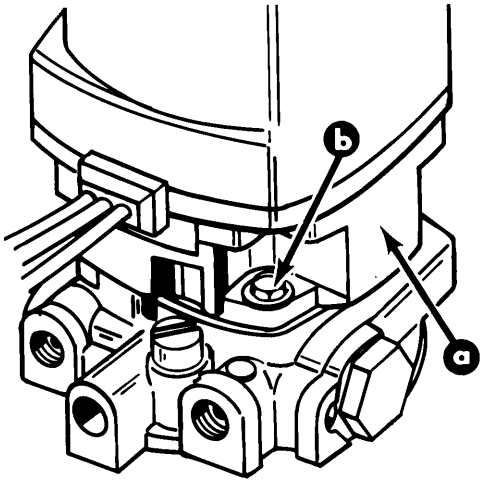


70870

a - Screws

Adaptor Replacement

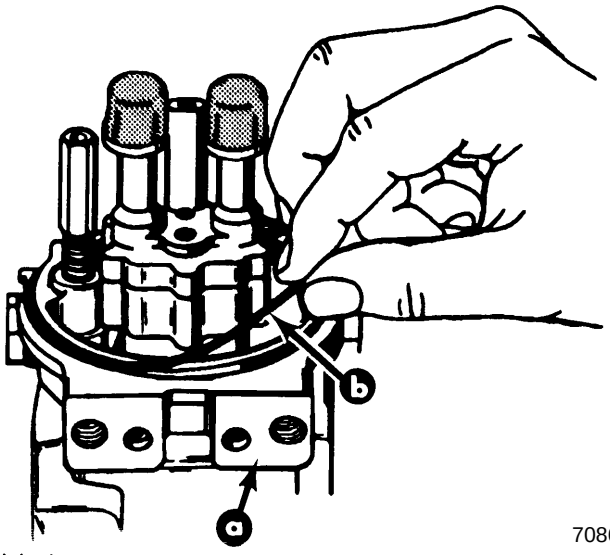
1. Remove pump motor attaching screws and remove motor from adaptor.



22548

a - Pump Motor
b - Screws (2)

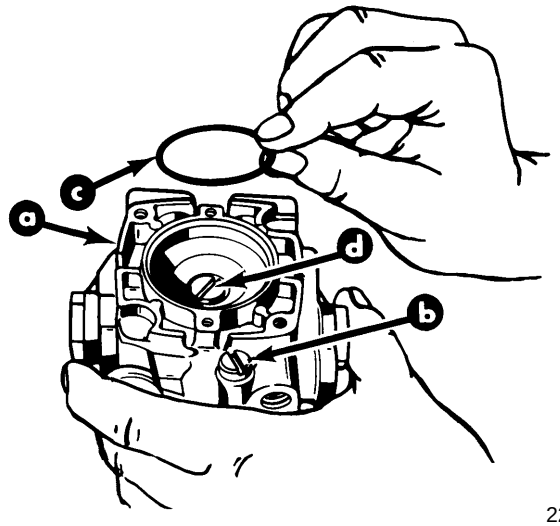
2. Remove and discard (adaptor to reservoir) O-ring.



70869

a - Adaptor
b - O-ring

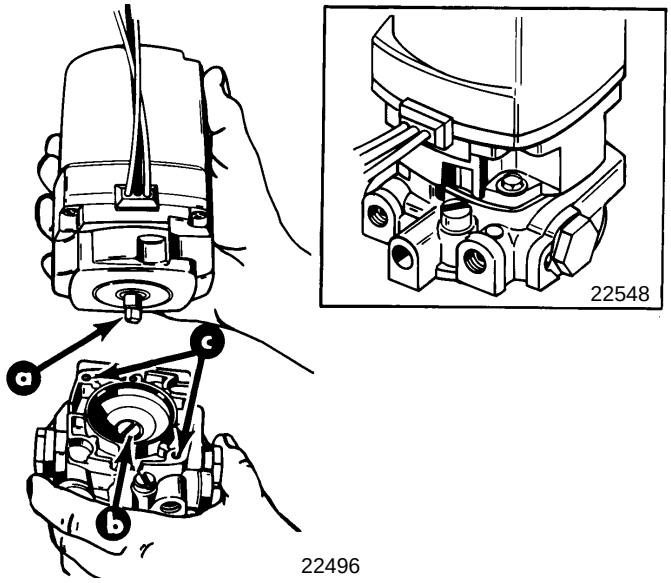
3. Remove and discard (motor to adaptor) O-ring.
4. Remove vent screw (dipstick) from old adaptor.
5. Install vent screw (dipstick) and new motor to adaptor O-ring.
6. Ensure coupling is installed so that shallow slot is toward reservoir. Lubricate coupling with 2-4-C Marine Lubricant.



22498

a - Adaptor
b - Vent Screw (Dipstick)
c - O-ring
d - Coupling-(Shallow Slot Toward Reservoir)

7. Align motor shaft with coupling and install motor onto adaptor. Position as shown and secure with screws. Tighten securely.



22548

22496

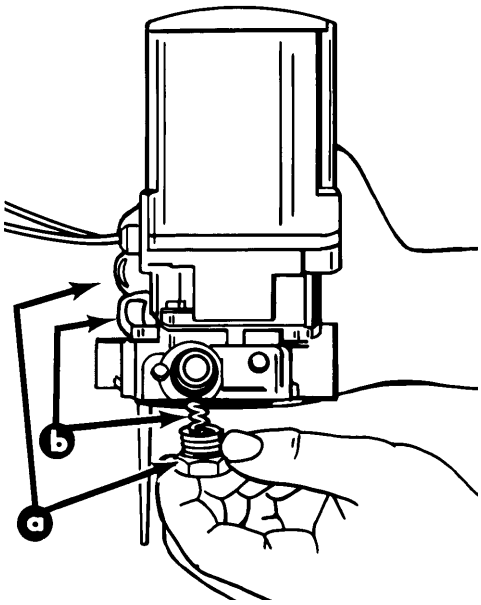
a - Motor Shaft
b - Coupling
c - Screws (Opposite Corners)

8. Install adaptor and O-ring.

Adaptor Repair

INTERNAL O-RING AND POPPET VALVE REPLACEMENT

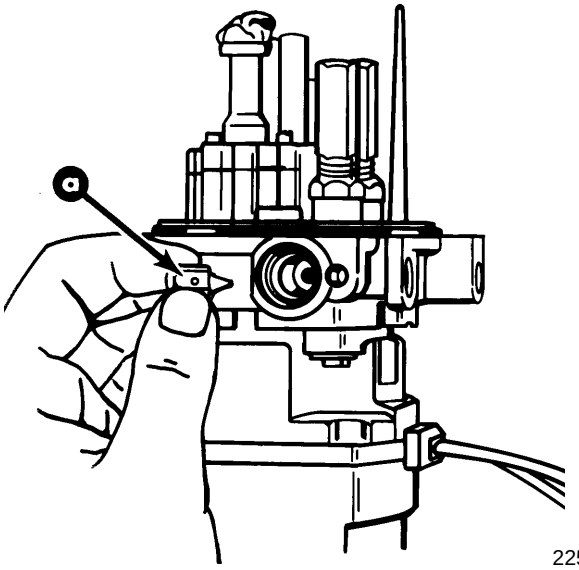
1. Remove hex plug retainers and springs (one on each side).



22549

a - Hex Plug Retainers (2)
b - Springs (2)

2. Remove and discard poppet valves.



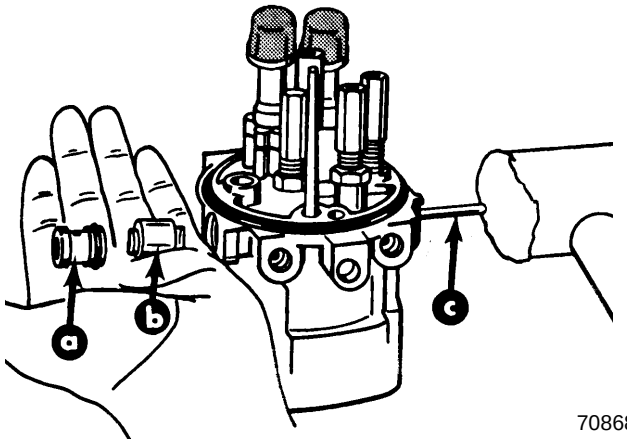
22549

a - Poppet Valves

⚠CAUTION

Use care in removing check valve bodies from adaptor, so as not to damage poppet valve seat surface on valve body.

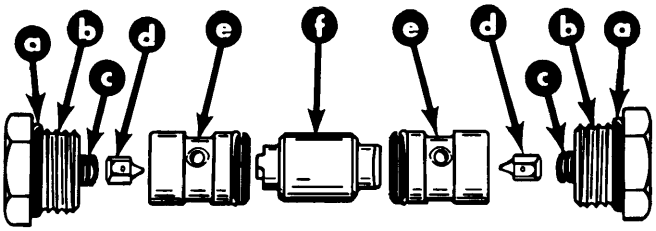
3. Remove check valve bodies and spool.



70868

a - Check Valve Body (2)
b - Spool
c - 1/8 in. Diameter Rod (Provided With Trim Pump Rebuild Kit)

4. Remove and discard O-rings on hex plug retainers.
5. Discard check valve bodies.
6. Clean hex plug retainers and spool.



70867

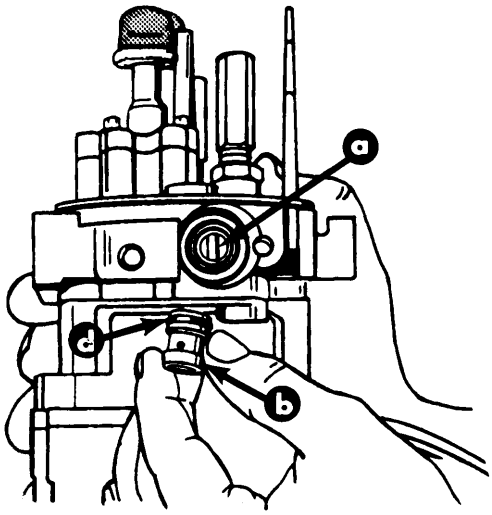
a - O-rings
b - Hex Plug Retainers
c - Springs
d - Poppet Valves
e - Check Valve Bodies
f - Spool

7. Lubricate check valve body O-rings with power trim and steering fluid, or with 10W-30 or 10W-40 motor oil.

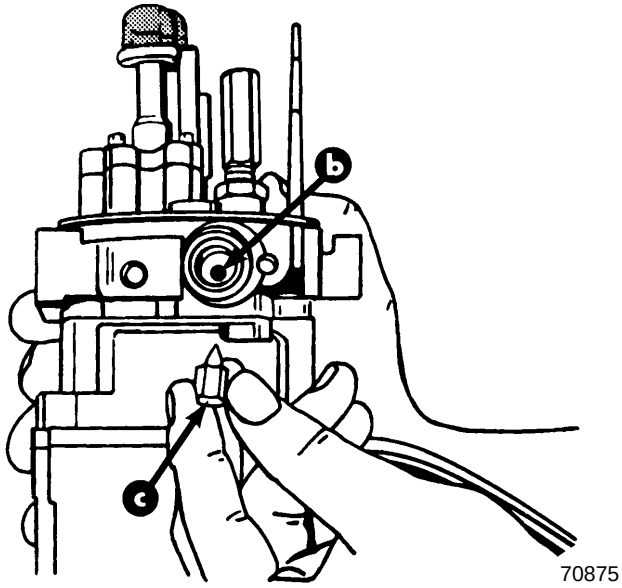
⚠CAUTION

DO NOT force check valve bodies into adaptor as damage to O-rings may result.

8. Place spool and check valve bodies into adaptor.
9. Place poppet valves into check valve bodies.



70874

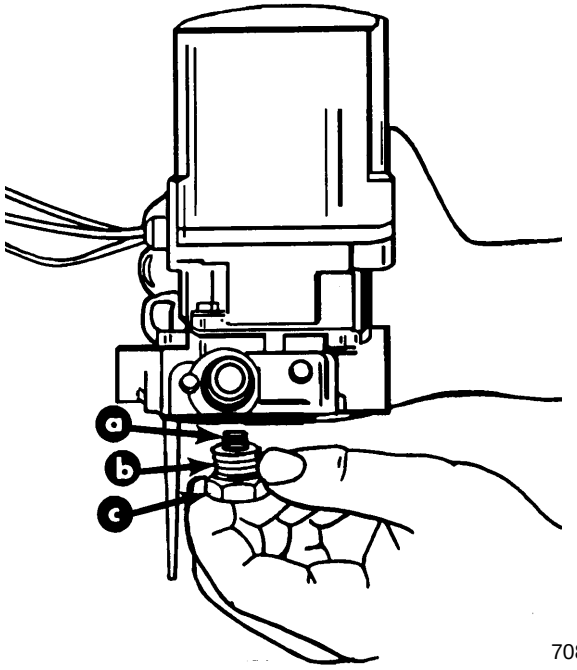


70875

a - Spool
b - Check Valve Body (2)
c - Poppet Valve (2)
d - Check Valve Body O-ring (2)

10. Lubricate hex plug retainer O-rings with Quicksilver Power Trim and Steering Fluid, or 10W-30, or 10W-40 motor oil.
11. Place spring into hex plug retainers.

12. Thread hex plug retainers into adaptor by hand until retainer contacts check valve body.



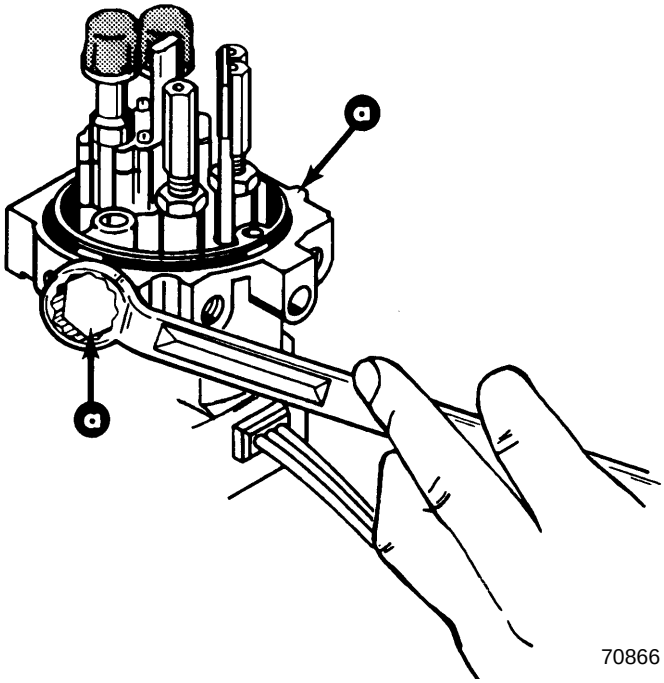
70871

a - Spring (2)
b - O-ring (2)
c - Hex Plug Retainer (2)

⚠CAUTION

Hex plug retainers MUST BE turned into adaptor exactly as outlined or damage to check valve body O-rings may result.

13. Tighten hex plug retainer 1/4 turn, then back off 1/8 turn. Repeat until hex plug is tightened securely.

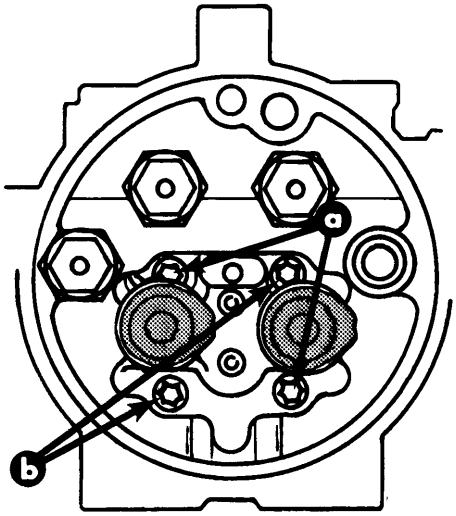


70866

a - Hex Plug Retainer (2)

Pump Shaft Oil Seal Replacement

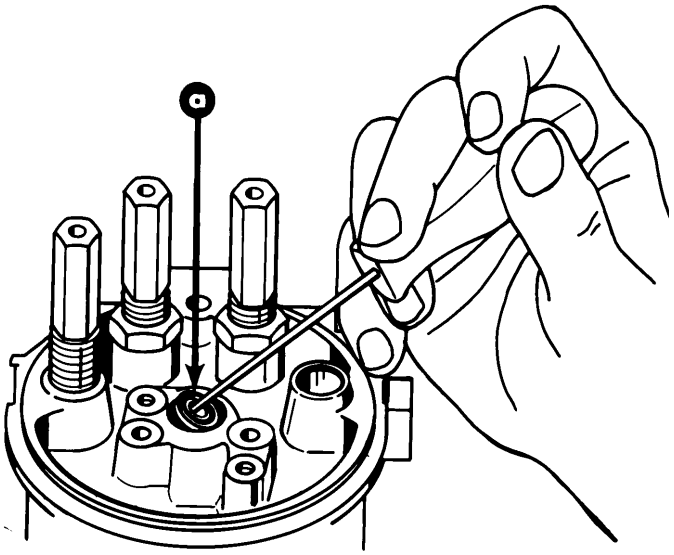
1. Remove reservoir.
2. Remove pump attaching screws and pump. DO NOT remove pump assembly screws.



70870

a - Screws
b - Pump Assembly Screws

3. Remove oil seal by prying out with a screwdriver.

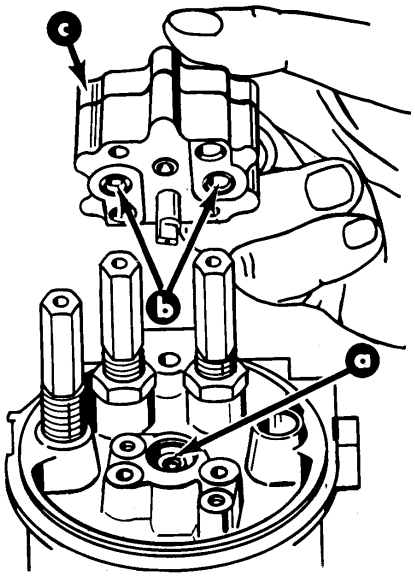


50371

a - Oil Seal

4. Remove and replace O-rings on pump base.
5. Install new seal with lips toward pump. Oil seal can be pressed in by hand.

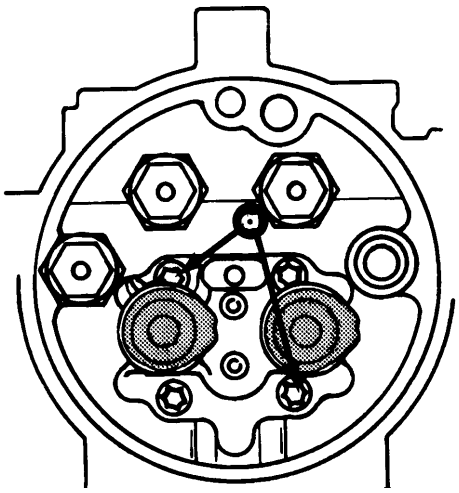
6. Lubricate lip of seal with light weight oil. Replace O-rings if necessary.



22545

a - Oil Seal-Lip Toward Pump
b - O-rings

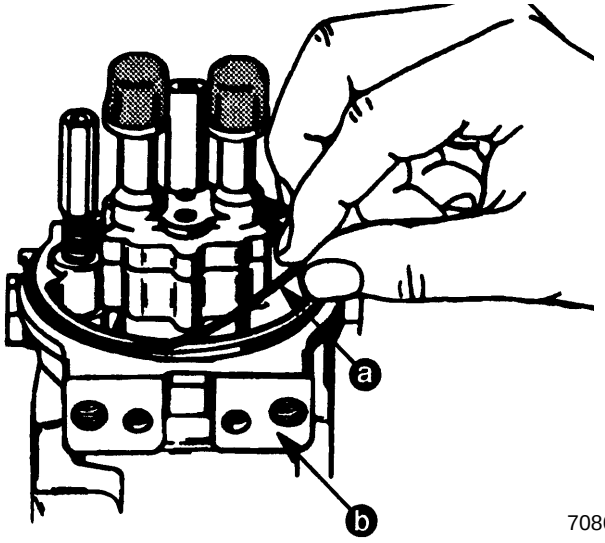
7. Install pump and torque screws to 75 lb. in. (8 N·m) using a hex lobular socket or a standard 3/16 inch socket.



70870

a - Screws

8. Install a new pump to reservoir O-ring.



70869

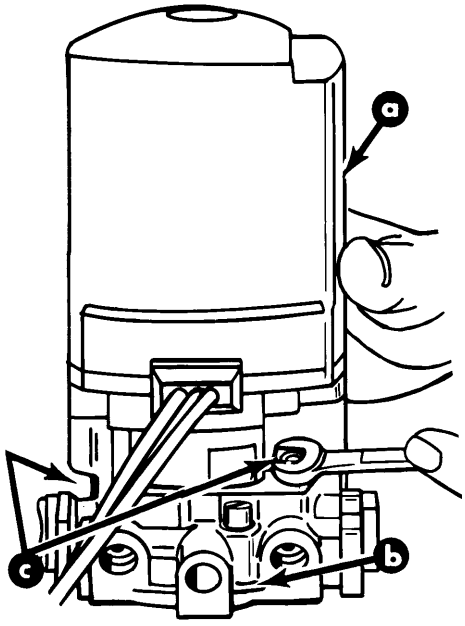
a - O-ring
b - Adaptor

9. Install reservoir.

Motor Repair

Disassembly

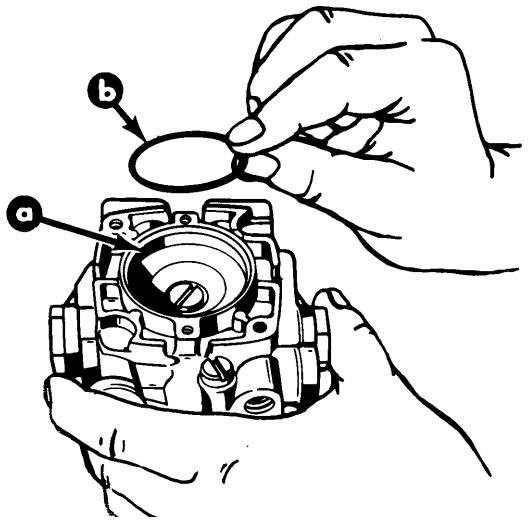
1. Remove trim motor from adaptor.



22546

a - Trim Motor
b - Adaptor
c - Screws

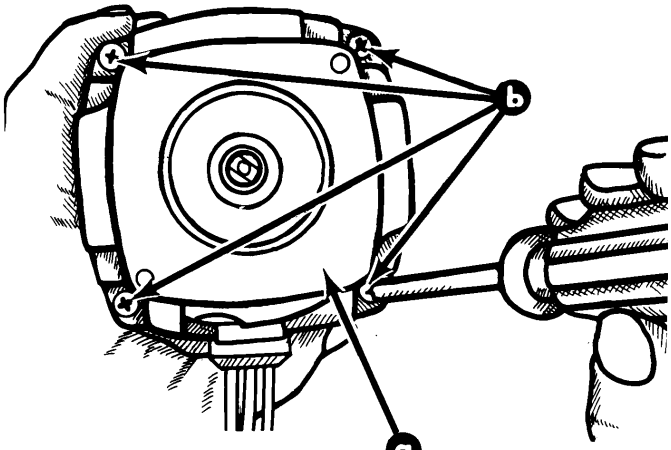
2. Remove (motor-to-adaptor) O-ring.



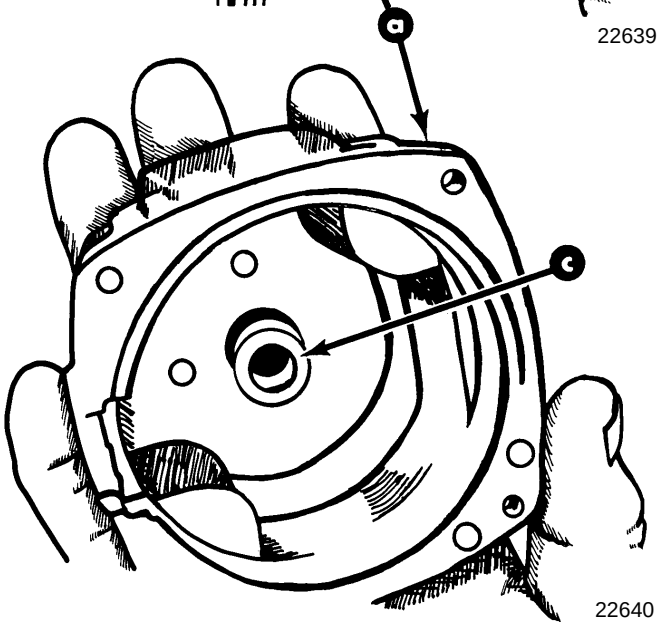
22498

a - Adaptor
b - O-ring

3. Remove motor end cover and washer from armature shaft bushing.



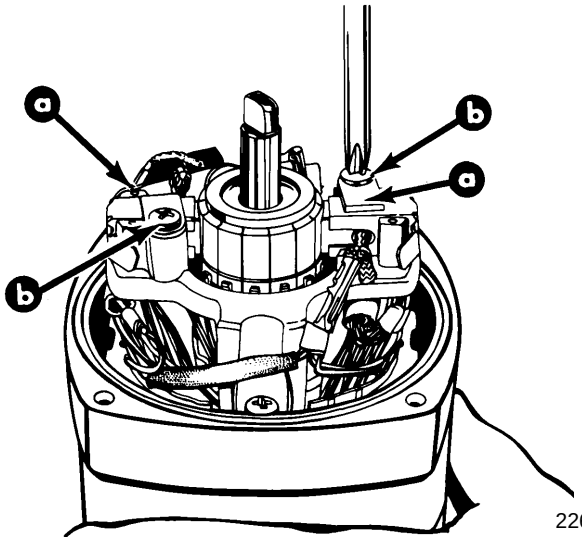
22639



22640

a - Cover
b - Screws (4)
c - Washer

4. Loosen brush hold down arms.

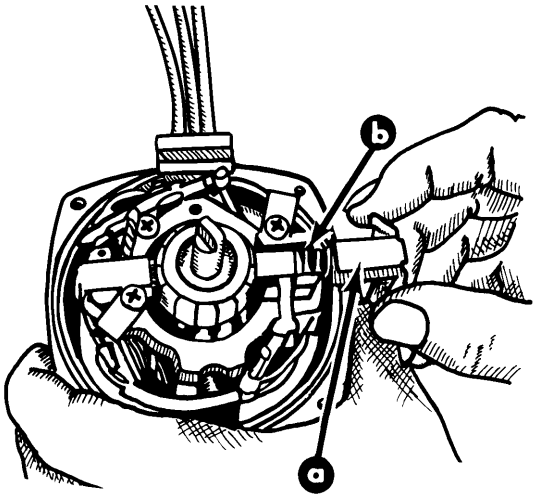


22648

a - Brush Hold Down Arms
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

5. Remove brush holders and springs.

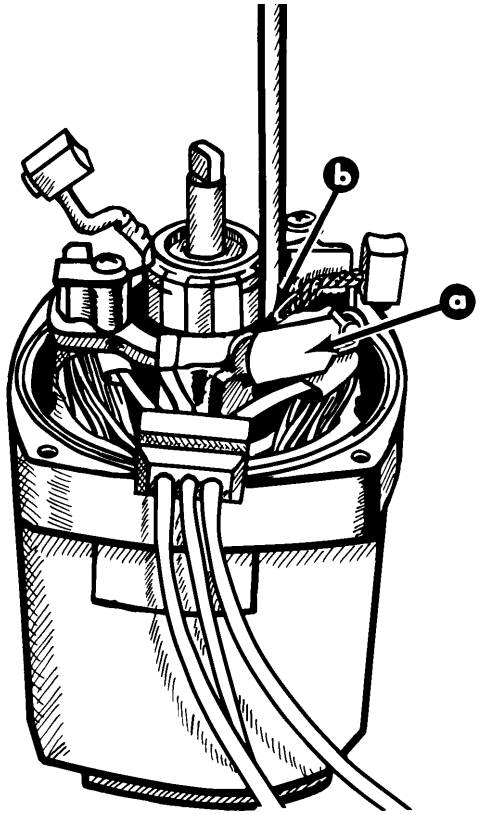


22638

a - Brush Holder
b - Spring

Index

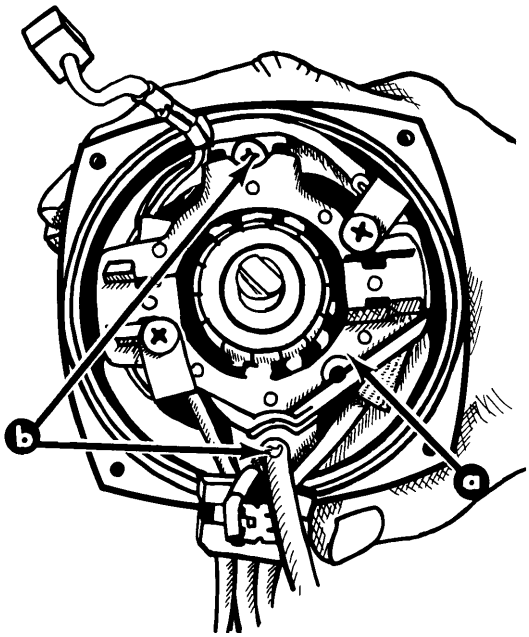
6. Remove thermal switch and brush assembly.



22637

a - Thermal Switch And Brush
b - Screw

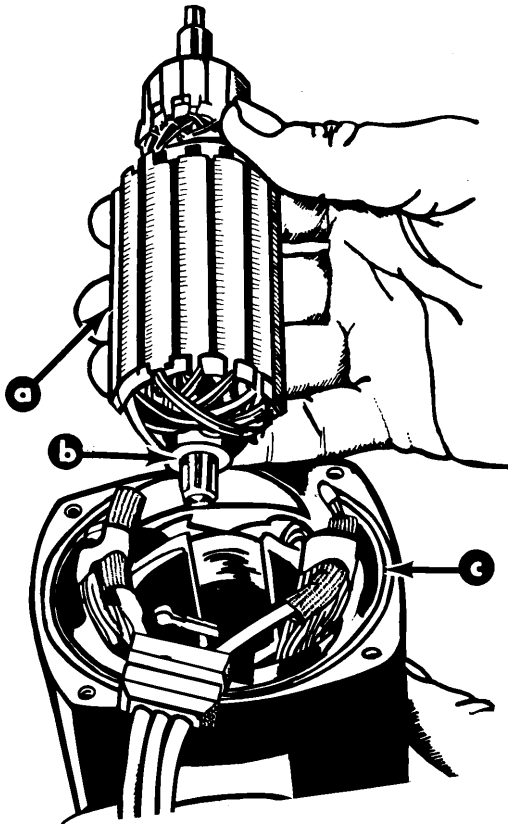
7. Remove brush assembly mounting bracket.



22636

a - Brush Assembly Mounting Bracket
b - Screws

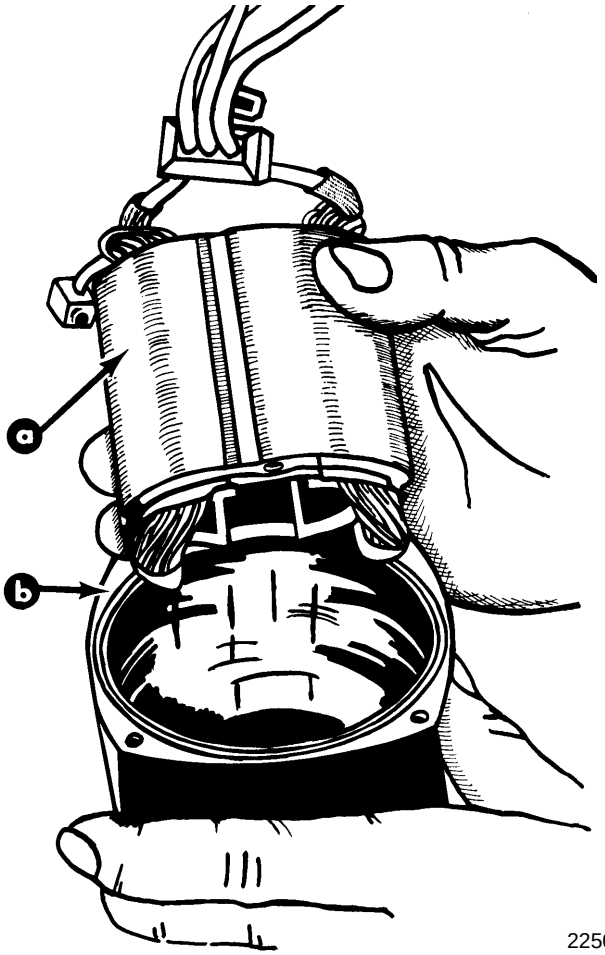
8. Remove armature and thrust washer from motor housing.



22499

a - Armature
b - Thrust Washer
c - Motor Housing

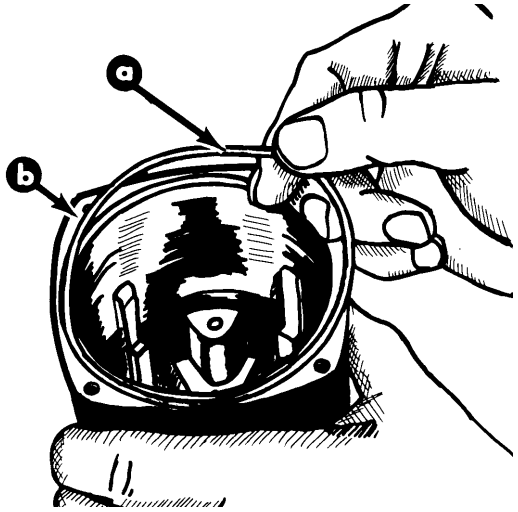
9. Remove field assembly from motor housing.



22501

a - Field Assembly
b - Motor Housing

10. Remove motor housing O-ring.



22645

a - O-ring
b - Motor Housing

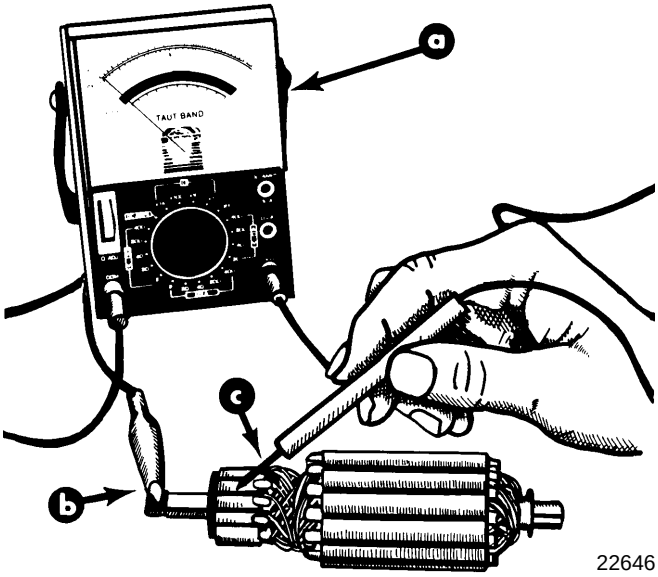
Armature Tests

CONTINUITY TEST

1. Check armature for continuity. Set ohmmeter on Rx1 scale. Place one lead on armature shaft and then place the other on each commutator bar.

Continuity Indicated-Armature is grounded (replace armature).

Continuity Not Indicated-Armature is not grounded.



22646

a - Ohmmeter
b - Meter Lead-Place On Armature Shaft
c - Meter Lead-Place On All Commutator Bars (One At A Time)

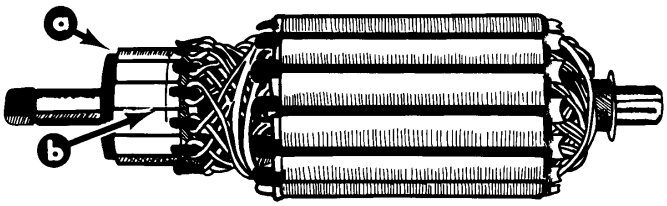
TEST FOR SHORTS

1. Check armature on a growler (follow growler manufacturers instructions). Indication of a short requires replacement.

CLEANING COMMUTATOR

NOTE: *If commutator is worn it can be turned down on a lathe or an armature conditioner tool.*

1. Clean commutator with “OO” garnet grit sandpaper. DO NOT use emery paper.
2. Check gaps between commutator bars for material. Remove material if present.



22647

a - Commutator
b - Gap

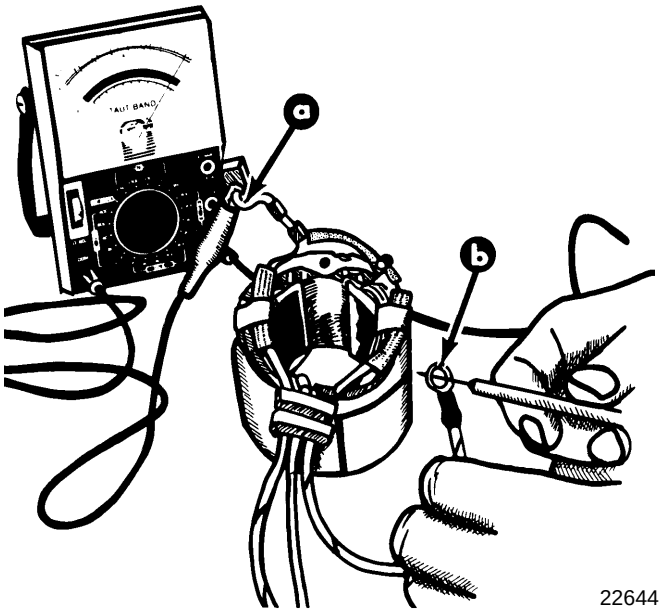
Field Tests

TEST FOR OPEN CIRCUIT

1. Connect ohmmeter between field brush lead and BLUE/WHITE lead.

Zero Ohms Indicated (full continuity)-Field OK.

Zero Ohms Not Indicated (no continuity)-Replace field assembly.



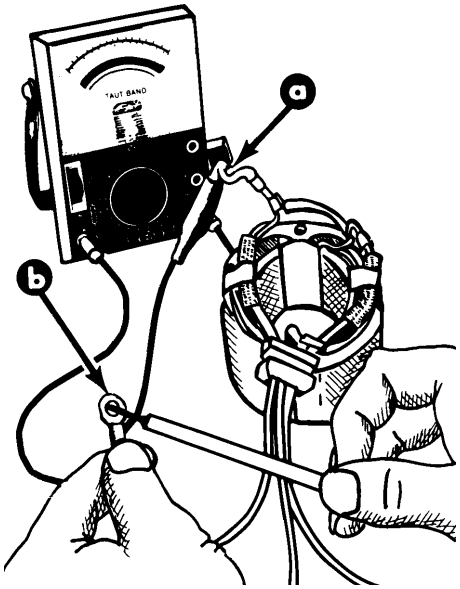
22644

a - Ohmmeter Lead-Connected To Brush Lead
b - Ohmmeter Lead-Connected To BLUE/WHITE Lead

2. Connect ohmmeter between field brush lead and GREEN/WHITE lead.

Zero Ohms Indicated (full continuity)-Field OK.

Zero Ohms Not Indicated (no continuity)-Replace field assembly.



22642

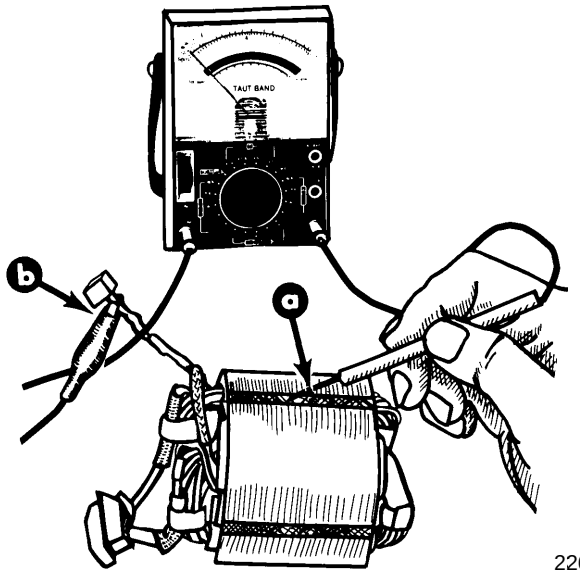
a - Ohmmeter Lead-Connected To Brush Lead
b - Ohmmeter Lead-Connected To GREEN/WHITE Lead

TEST FOR SHORT IN FIELD

1. Connect ohmmeter between field brush lead and field frame.

Zero Ohms Indicated (full continuity)-Short indicated (replace field assembly)

Zero Ohms Indicated (no continuity) - field OK.



22643

a - Field Frame
b - Field Brush Lead

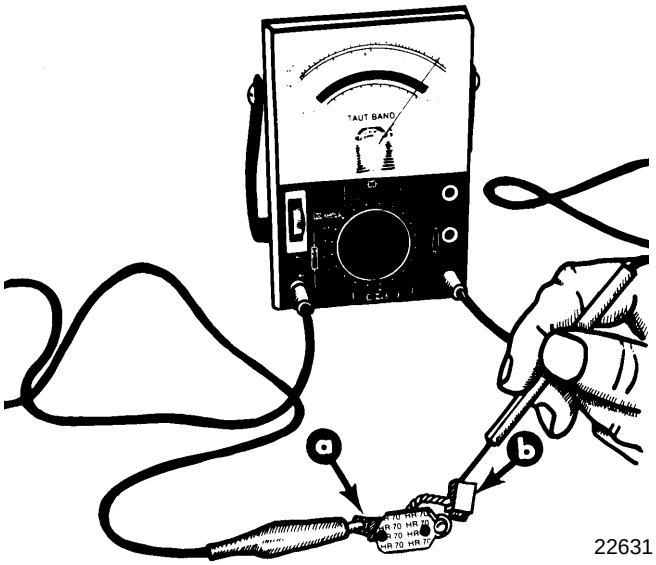
Thermal Switch Test

CONTINUITY TEST

1. Connect ohmmeter between spade connector and brush lead.

Zero Ohms Indicated (full continuity)-Proceed to Step 2.

Zero Ohms Not Indicated (no continuity)-Replace thermal switch.



22631

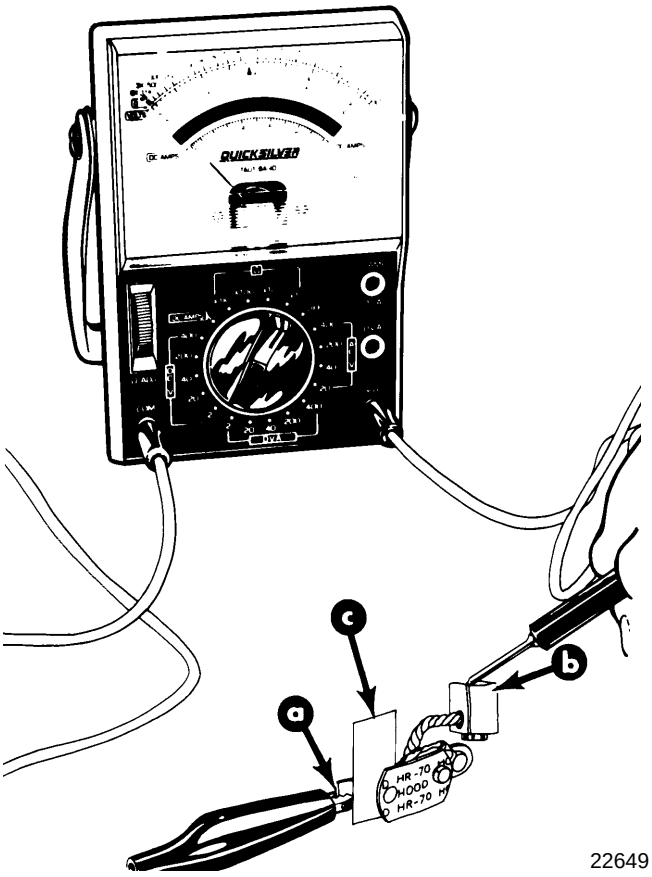
a - Thermal Switch Spade Connector
b - Brush Lead

Index

2. Insert an insulator (piece of paper) between contact points on ohmmeter between spade connector and brush lead.

Zero Ohms Indicated (full continuity)-Replace thermal switch.

Zero Ohms Not Indicated (no continuity)-Thermal switch OK.



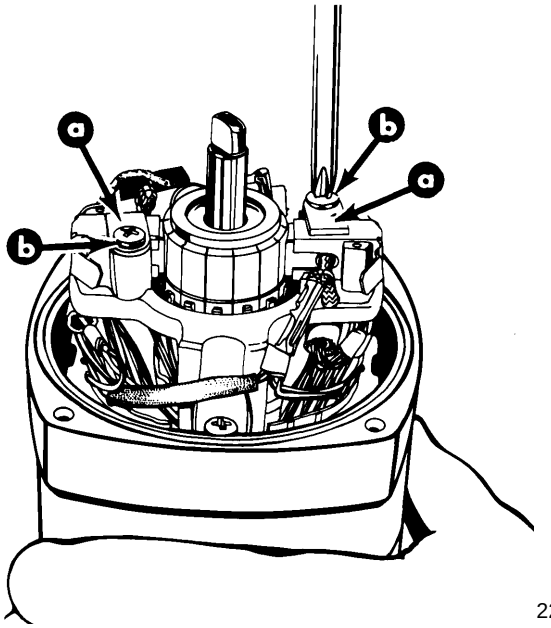
22649

a - Thermal Switch Spade Connector
b - Brush Lead
c - Insulator (Piece Of Paper)

3. Remove insulator from between contact points on thermal switch. Ensure all material is clear from points.

Brush Replacement

1. Loosen brush hold down arms.

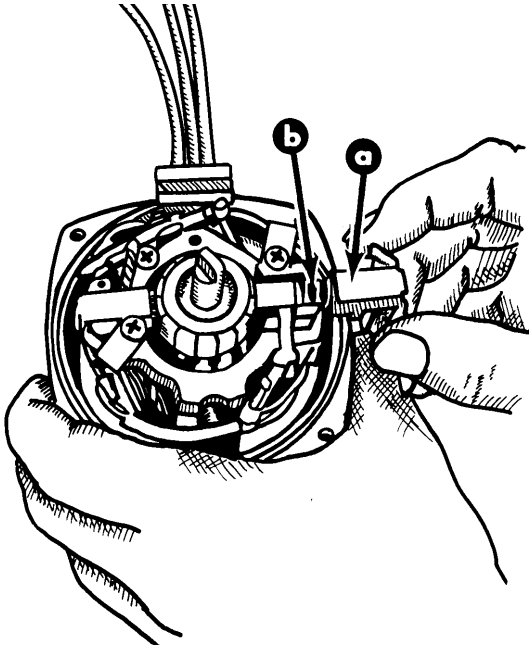


22648

a - Brush Hold Down Arm
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

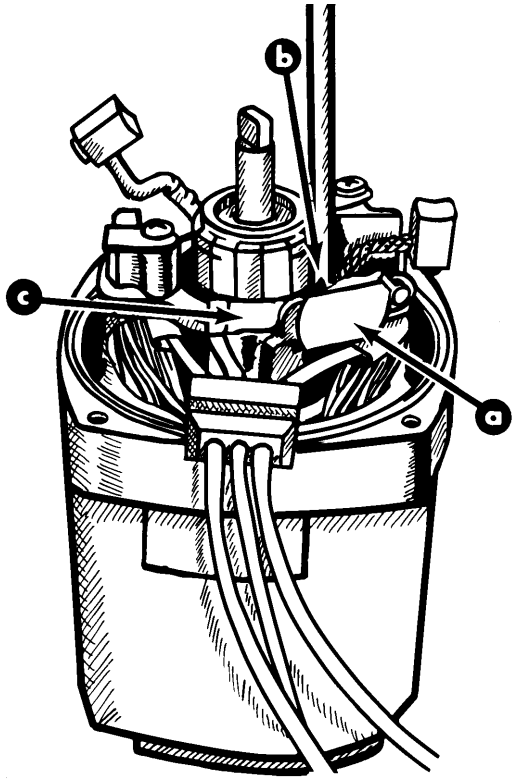
2. Remove brush holders and springs.



22638

a - Brush Holders
b - Springs

3. Remove and replace thermal switch and brush assembly.

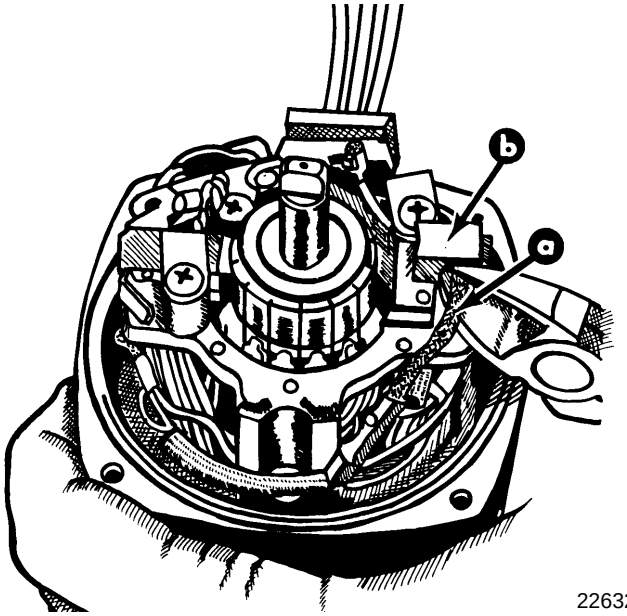


22637

a - Thermal Switch And Brush
b - Screw
c - Connector

IMPORTANT: When replacing the brush that is connected to the field wires; be sure to cut the brush wire as close to the brush as possible.

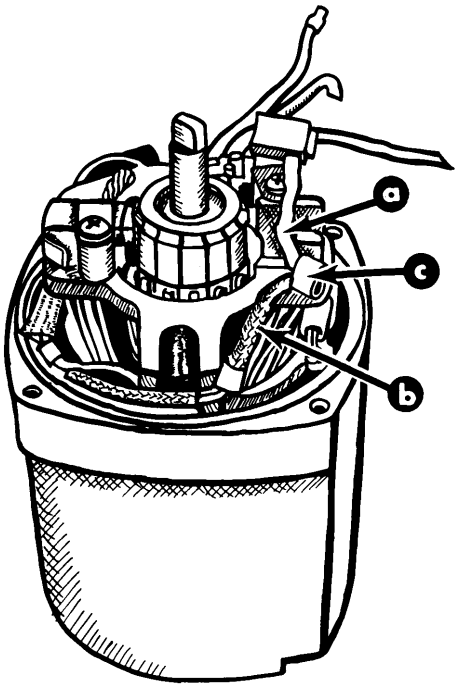
4. Cut brush wire at location shown and discard brush. (As close to brush as possible.)



22632

a - Brush Wire
b - Brush

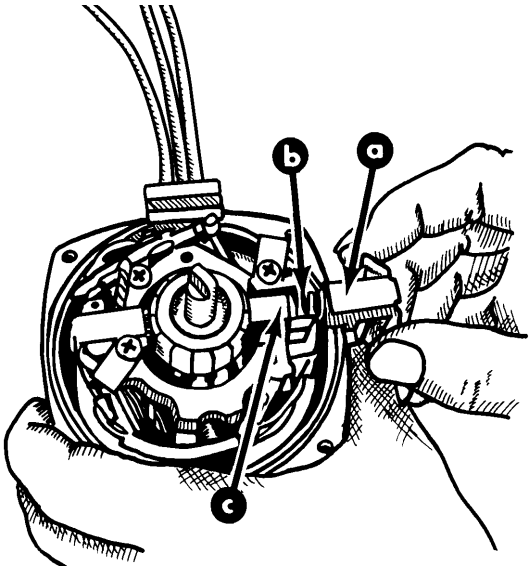
5. Connect new brush wire to field wire just cut in previous step. Secure by crimping both wires together as shown.



22635

a - Brush Wire
b - Field Wire (Old Brush Wire)
c - Crimp Connector

6. Reinstall spring and brush in brush holder.

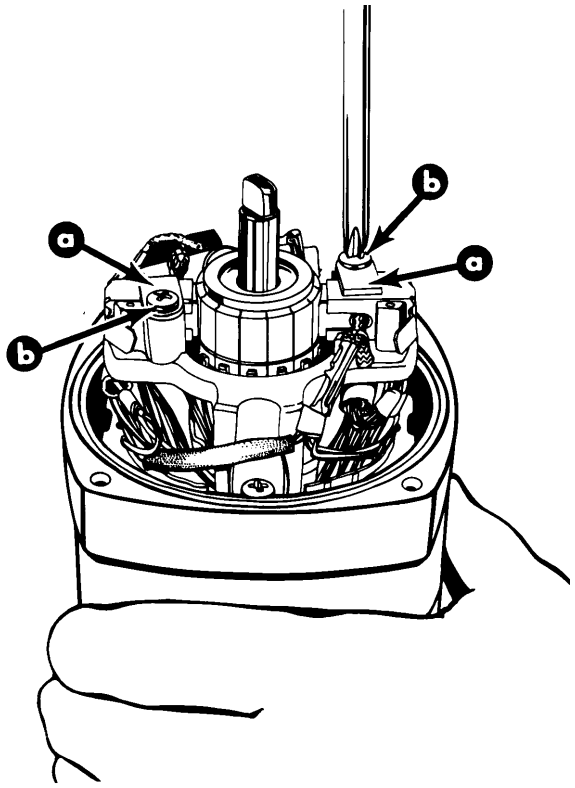


22638

a - Brush Holder
b - Spring
c - Brush

Index

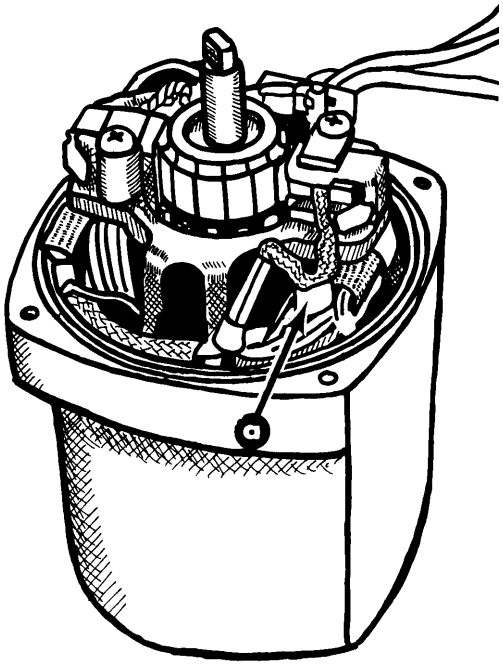
7. Position and tighten brush hold down arms and tighten securely. DO NOT OVERTIGHTEN.



22648

a - Brush Hold Down Arms
b - Screws

8. Position brush wire as shown before reassembly.



22634

a - Brush Wire

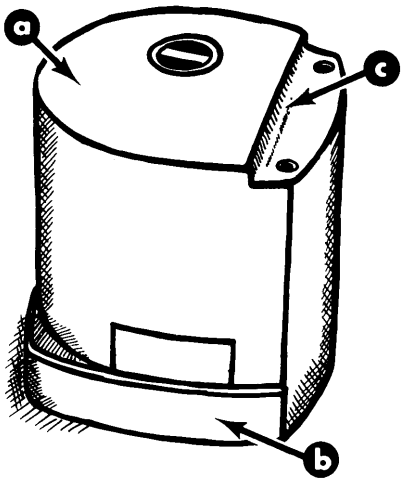
Reassembly

1. Install motor housing O-ring.

22645

a - O-ring
b - Motor Housing

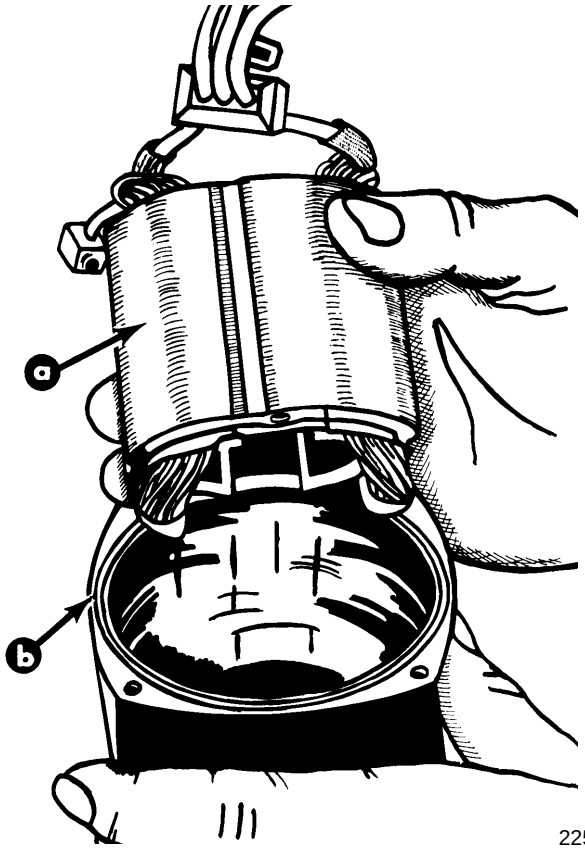
IMPORTANT: Field assembly wires must be facing toward the front of motor housing. Use the notched out area in housing as a reference in determining the front.



22633

a - Motor Housing
b - “Front”
c - “Notched Out” Area

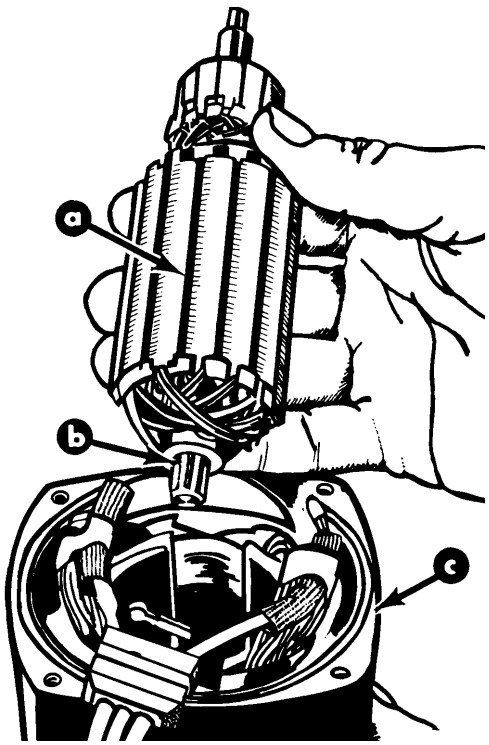
2. Install field assembly into motor housing.



22501

a - Field Assembly
b - Motor Housing

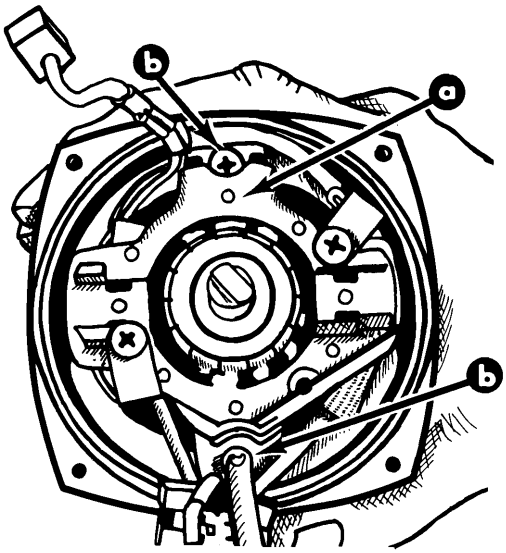
3. Install thrust washer on armature and install into motor housing.



22499

a - Armature
b - Thrust Washer
c - Motor Housing

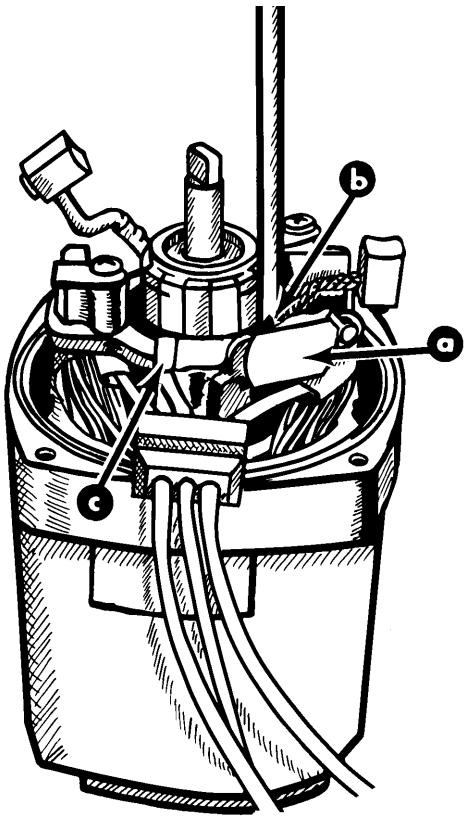
4. Install brush assembly mounting bracket. Tighten screws securely.



22636

a - Brush Assembly Mounting Bracket
b - Screw

5. Install thermal switch and connect black wire. DO NOT overtighten screw.



22637

a - Thermal Switch
b - Screw
c - Black Wire Connector

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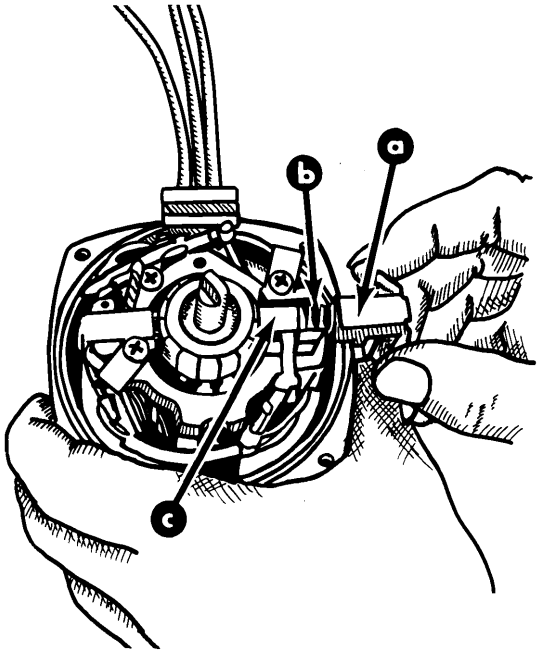
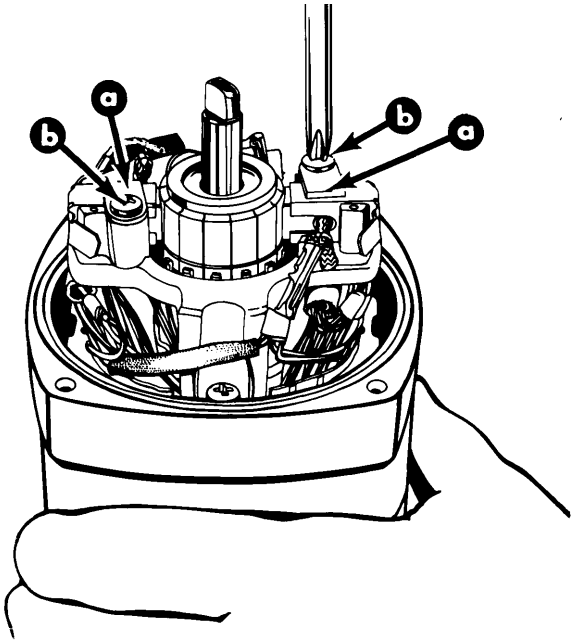
6. Install springs and brushes into brush holders.



22638

a - Brush Holders
b - Springs
c - Brushes

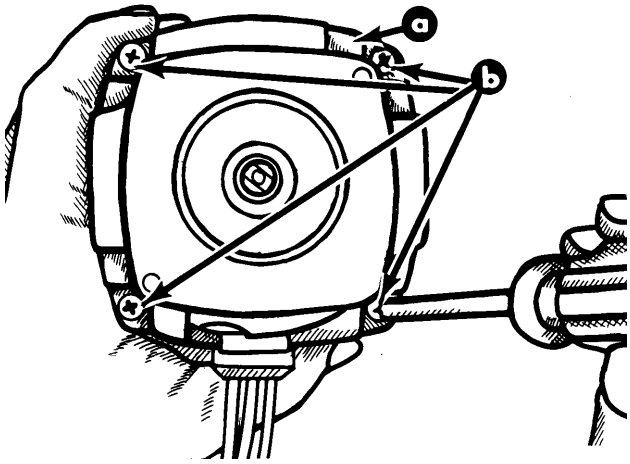
7. Position brush holders and secure with brush hold down arms. DO NOT overtighten screws.



22648

a - Brush Hold Down Arms
b - Screws

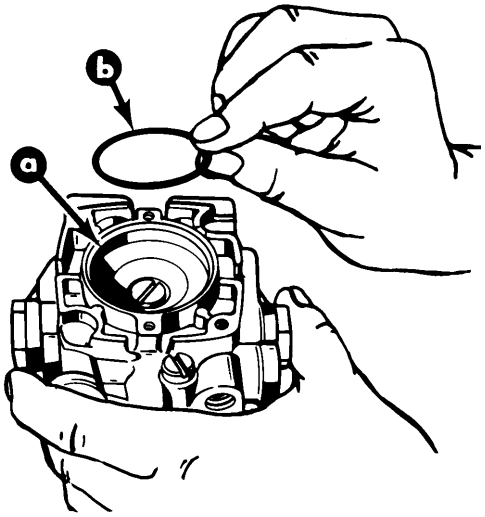
8. Install thrust washer and motor end cover. Apply Loctite to screws and tighten securely. DO NOT overtighten.



22639

a - Motor End Cover
b - Screws

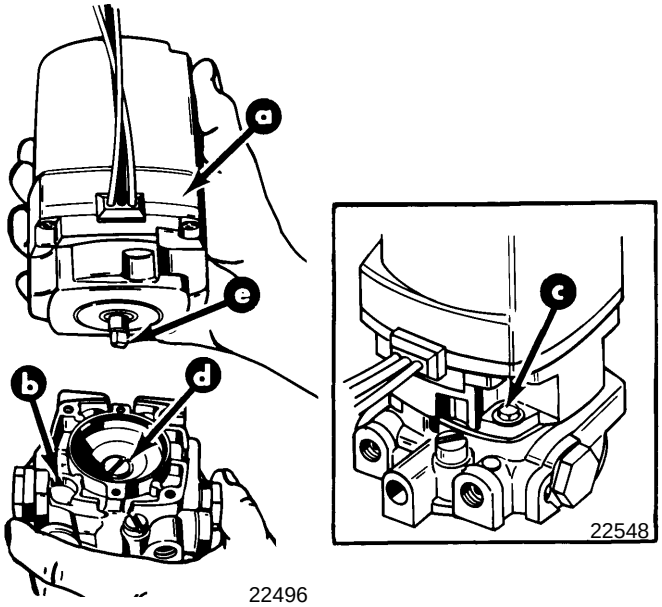
9. Install (motor-to-adaptor) O-ring.



22498

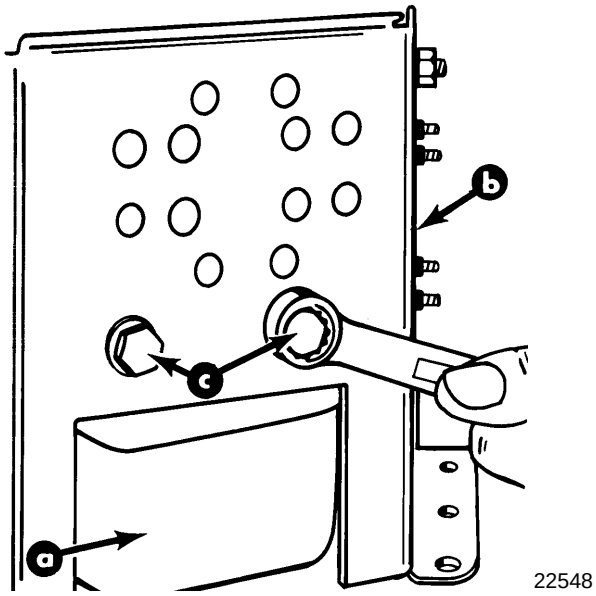
a - Adaptor
b - O-ring

10. Align motor shaft with coupler and install trim motor on adaptor. Torque screws to 25 lb. in. (2.8 N·m).



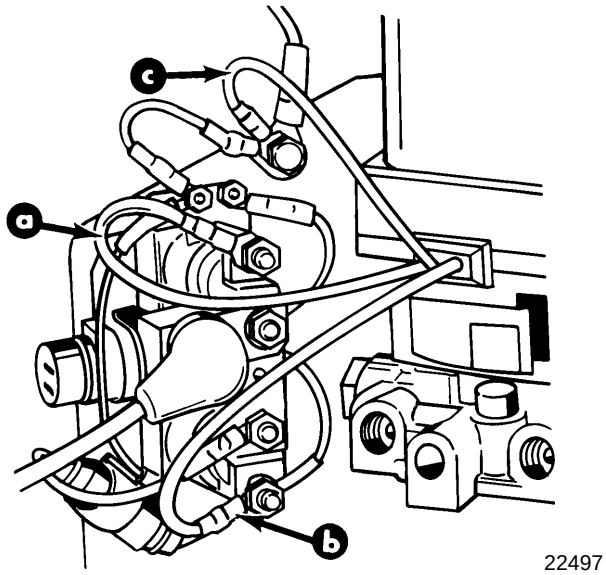
a - Trim Motor
b - Adaptor
c - Screws (2) (Opposite Corners)
d - Coupler
e - Motor Shaft

11. Install trim pump on floor bracket. Tighten securely.



a - Trim Pump
b - Floor Bracket
c - Screws And Lock Washers

12. Connect trim motor wires to solenoids as shown.

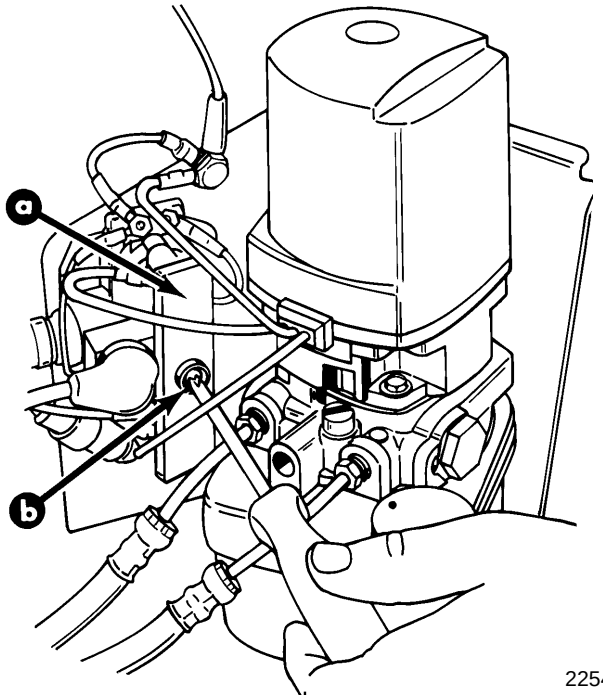


a - BLUE/WHITE Motor Wire
b - GREEN/WHITE Motor Wire
c - BLACK Ground Wire

⚠CAUTION

Solenoid terminal cover screw is attached to 12 volt positive source. DO NOT GROUND screwdriver when installing cover.

13. Install solenoid terminal cover. Tighten screw securely.



a - Solenoid Terminal Cover
b - Screw

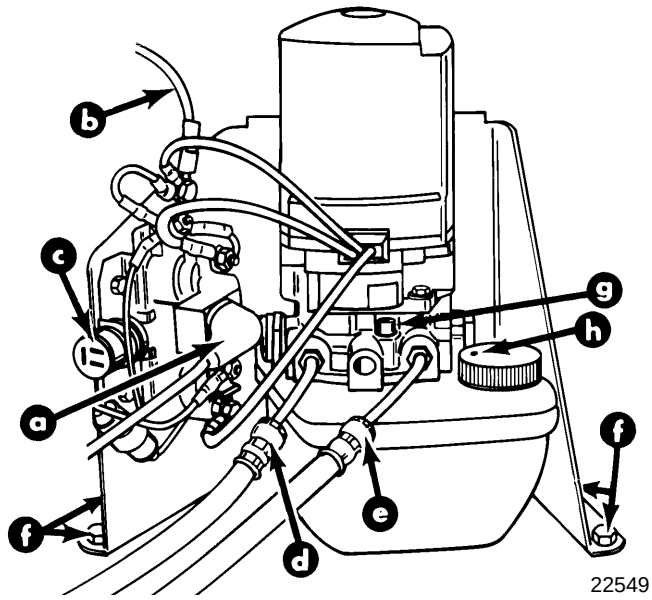
Trim Pump Installation

1. Secure pump and mounting bracket to boat using lag bolts and washers.
2. Reconnect trim hoses to pump. Black hose to left connection; gray hose to right connection. DO NOT cross-thread or overtighten hose fittings. Torque to 70-150 lb. in. (7.9-16.9 N·m).
3. Reconnect trim harness connector to trim pump.
4. Reconnect battery leads to battery.

⚠ CAUTION

Fill cap is vented. Be sure to remove "Caplug" (fill neck seal) from fill neck on new replacement pumps. Failure to do this can damage pump, when operated.

5. Check fluid level and fill if necessary. (Refer to "Maintaining Power Trim Pump Oil Level" in this section).

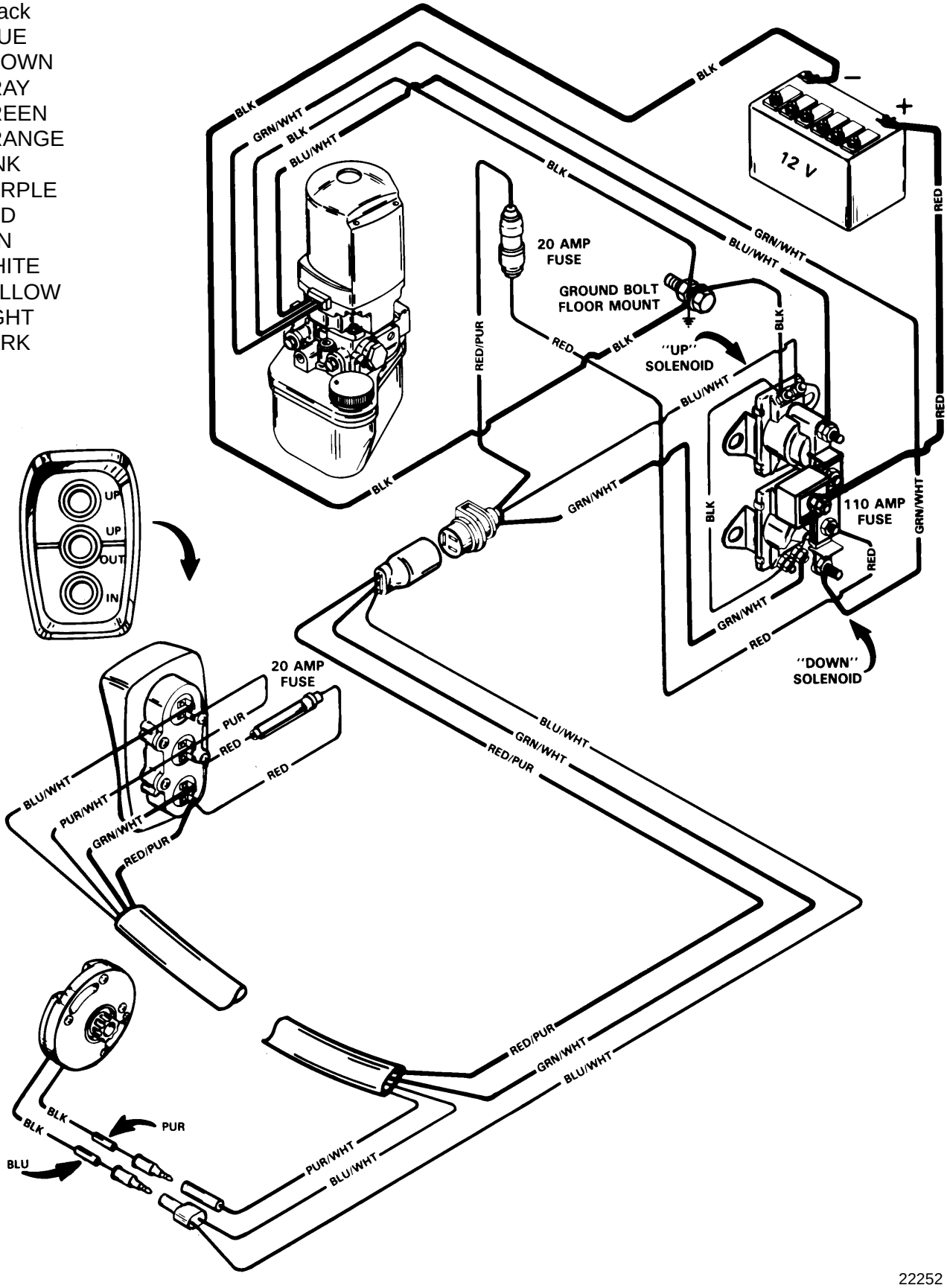


22549

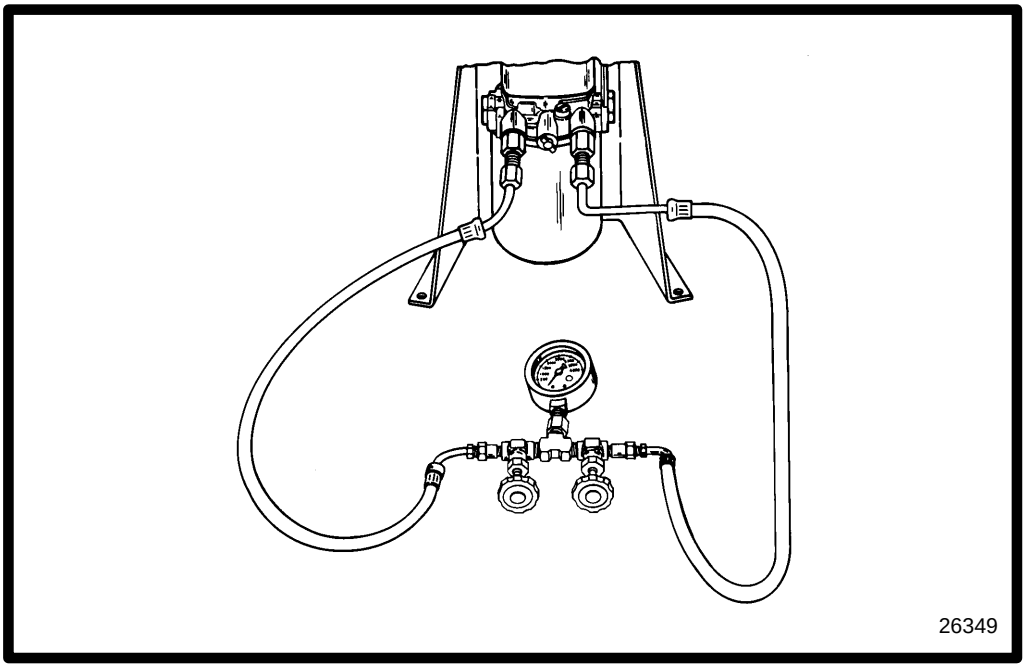
a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)
f - Lag Bolts and Washers
g - Vent Plug-Earlier Models; Replaced By Vented Fill Cap
h - Vent In Fill Cap

POWER TRIM WIRING DIAGRAM

BLK ● BLack
BLU ● BLUE
BRN ● BROWN
GRY ● GRAY
GRN ● GREEN
ORN ● ORANGE
PNK ● PINK
PUR ● PURPLE
RED ● RED
TAN ● TAN
WHT ● WHITE
YEL ● YELLOW
LIT ● LIGHT
DRK ● DARK



POWER TRIM



5
B

OILDYNE POWER TRIM PUMP (WITH ALUMINUM RESERVOIR)

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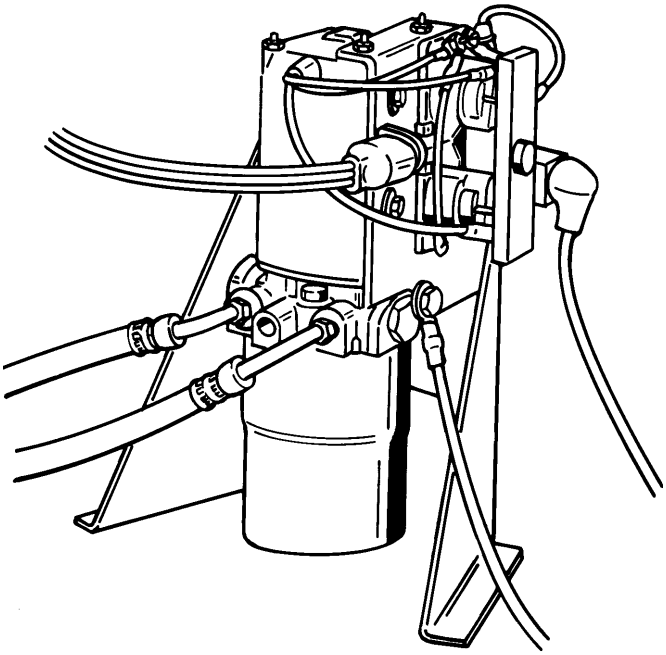
Identification

All MerCruiser 120R-MR through 260R-MR Sterndrives are equipped with either the Oildyne or Prestolite Power Trim pump. The Oildyne Power Trim pump is covered in this section. Refer to “Part B” for Prestolite pump information. (See “Index”)

The Oildyne Power Trim pump may be visually identified by the Power Trim pump’s “round” reservoir.



50494

Oildyne Power Trim Pump

Specifications

Valve Pressure Specifications

Valve	Pressure
Up Circuit	2200 - 2600 P.S.I. (15173 - 17932 kPa)
Down Circuit	400 - 600 P.S.I. (2759 - 4138 kPa)

Torque Specification

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Pump to Adaptor Screws	75		8

Electrical Specification

Pump Amperage Draw	115 Amps at 2200 - 2600 P.S.I. (15173 - 17932 kPa)

Lubricants/Sealers/ Adhesives

2-4-C Marine Lubricant	92-825407A2
Liquid Neoprene	92-25711-2
Needle Bearing Assembly Lubricant	92-825265A1

Special Tools

Test Gauge Kit	91-52915A6
Multi-Meter (Ohmmeter)	91-99750A1
Torx Socket	Obtain Locally

Description

The Oildyne Power Trim Pump has internal valving that eliminates the need for an external reverse lock, as was required in the past. The pump generates a higher volume of fluid, but at lower pressure than previous pumps. This, in conjunction with larger I.D. hydraulic hoses (gimbal housing to pump) and larger I.D. trim cylinders, should allow the drive unit to "kick-up" easier if an underwater object is struck.

⚠CAUTION

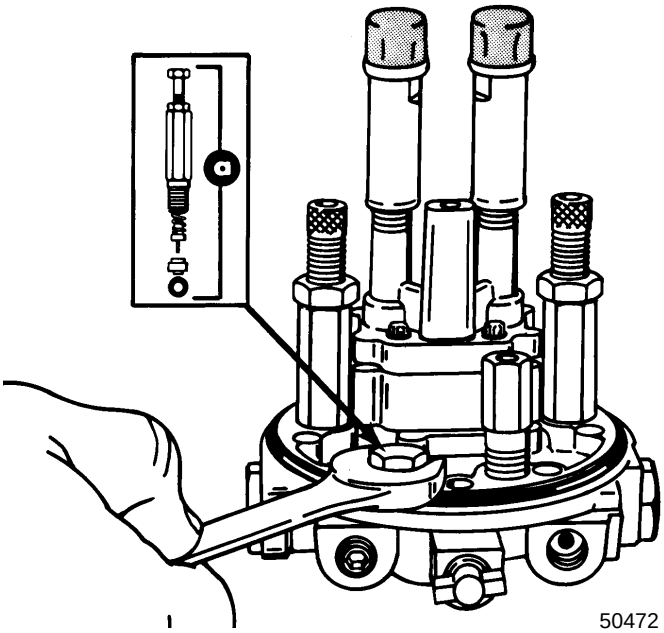
Due to differences in internal valving, the Oildyne trim pump cannot be used to replace an earlier high pressure Prestolite pump, or vice-versa. Use of incorrect pump will affect trim operation and may cause damage to trim system.

The pump motor is protected from overheating by an internal circuit breaker (in the field), which interrupts the ground circuit to the solenoids if an overheating condition is sensed. Electrical current overload protection is afforded to the pump by a 110-amp fuse. Pump also is equipped with a 20-amp circuit breaker (on older pumps) or a 20-amp fuse (on new pumps), which serves to protect the trim control and harness from an overload.

Special Information

Trail-Out Valve Removal

Early production Oildyne pumps were equipped with a trailout valve. This valve was eliminated on later pumps. If this valve should fail on one of the early production pumps, the valve can be removed and replaced with plug 19-11005A1.

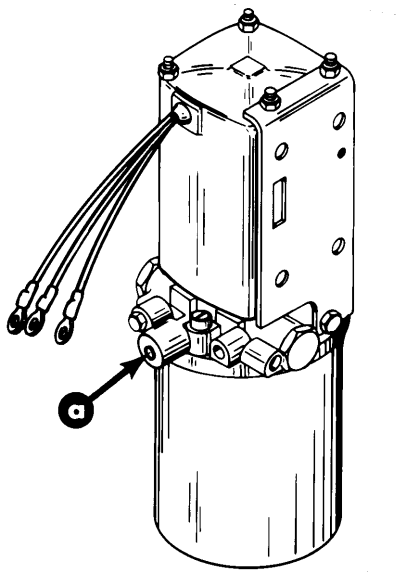


50472

a - Trail-Out Valve - Replaced with Plug 19-11005

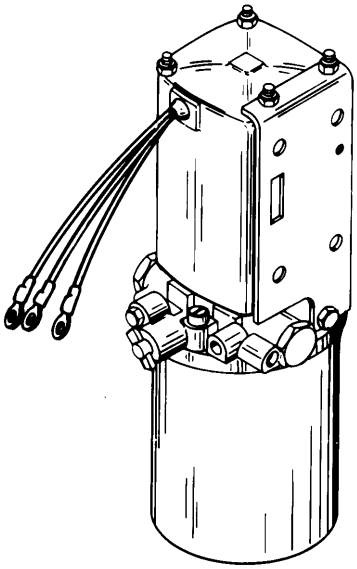
Manual Release Valve Removal

New production "Oildyne" Power Trim pumps will no longer have a "Manual Release Valve."



26348

New Production



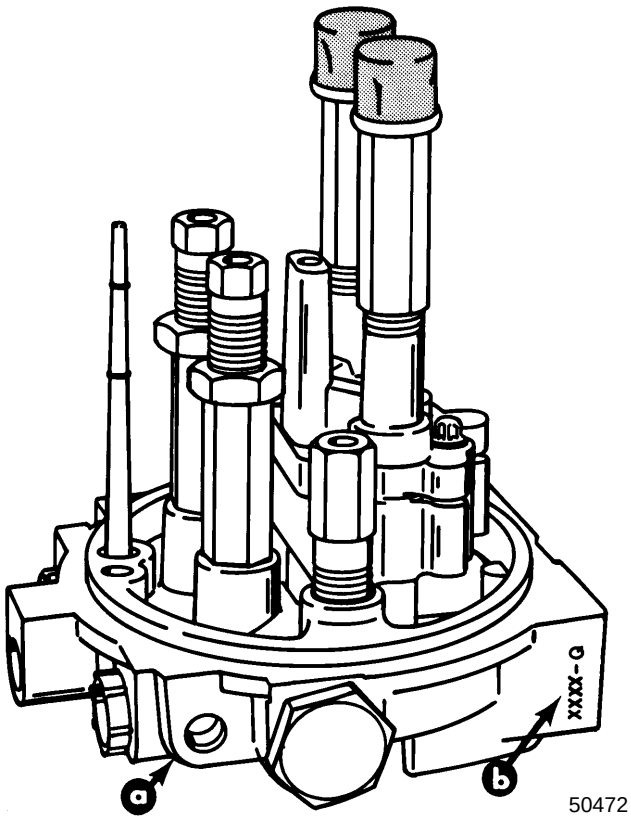
26348

Older Production

a - Manual Release Valve Has Been Removed From This Location

New Adaptor And Reservoir

Later production Oildyne pumps are equipped with a new adaptor. Accompanying this change, an aluminum (instead of stamped steel) oil reservoir was utilized.

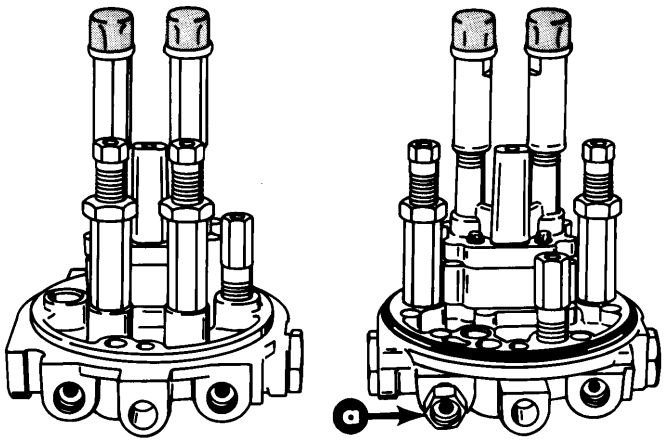


50472

New Adaptor Identification

a - Adaptor
b - Date Code Letter (Follows Number)
New casting - “Q”
Old casting - “P”

Adaptor fitting is no longer required on pumps with new adaptor. The gray hydraulic (DOWN) hose now attached directly to adaptor, the same as the black hydraulic hose.



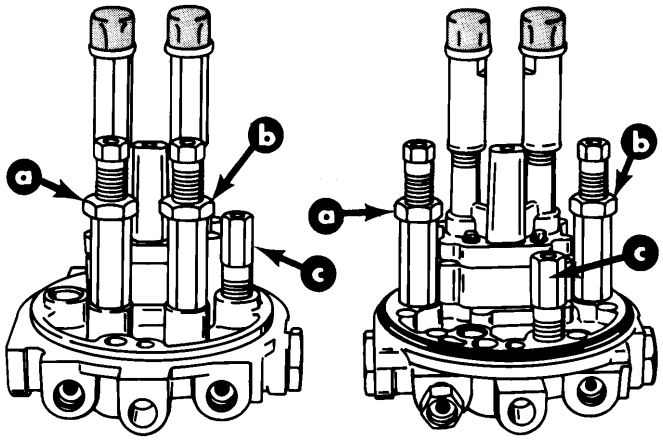
NEW ADAPTOR **OLD ADAPTOR**

50474

a - Adaptor Fitting - Used with Old Adaptor

With the exception of the aforementioned items, all other components are the same as those used on the older production pumps.

The locations of the pressure relief valves has been changed. Be sure to install the valves in the proper location when servicing these pumps. With this exception, the service procedure is the same.



NEW ADAPTOR **OLD ADAPTOR**

50474

a - Down Pressure Relief Valve
b - Up Pressure Relief Valve
c - Thermal Relief Valve

Thermal Circuit Breaker

If the IN/DOWN or “Trailer” switch is kept depressed after drive unit reaches its end of travel, a thermal circuit breaker will open to prevent pump motor from overheating and pump motor will stop. Release switch (es) as soon as drive unit reaches end of travel to prevent this from happening. If circuit breaker should open, allow motor to cool down and circuit breaker will automatically reset.

Manual Release Valve (If Equipped) Operation

NOTE: *Refer to “Special Information” (see “Index”).*

⚠WARNING

Before loosening manual release valve, make sure all persons are clear of sterndrive unit as unit may drop to the full IN/DOWN position if valve is opened too quickly.

In the case of a Power Trim system malfunction, the sterndrive unit can be raised and lowered manually by turning the manual release valve (if equipped) counterclockwise approximately 3 turns and moving drive unit to desired position by hand. After drive unit has been placed in the desired position, close valve COMPLETELY. Power Trim system will not function properly and damage to valve O-rings may result, unless valve is completely closed.

Maintaining Power Trim Pump Oil Level

⚠CAUTION

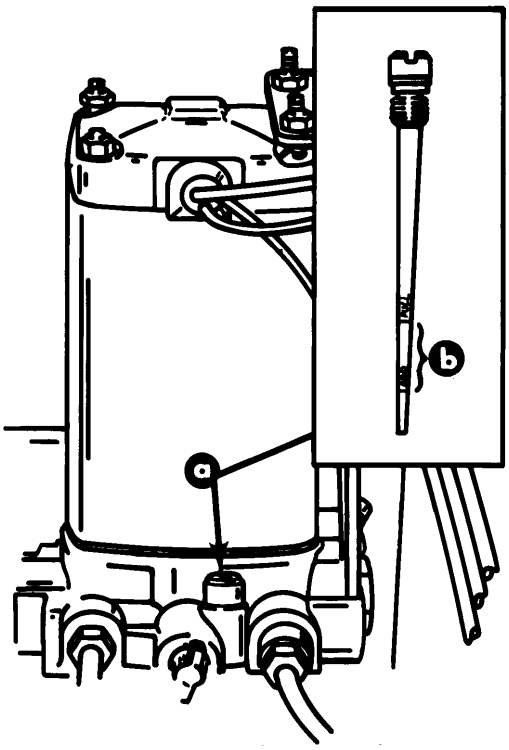
Fill/Vent screw MUST BE backed out one (1) full turn (after bottoming out) to vent pump reservoir. FAILURE TO BACK SCREW OUT COULD RESULT IN DAMAGE TO PUMP.

IMPORTANT: Check oil level wlth sterndrive unit in the full down position.

IMPORTANT: SAE 10W-30 or 10W-40 engine oil can be used in system, if Quicksilver Power Trim and steering fluid is not available.

1. Place sterndrive unit in the full IN/DOWN position.
2. Remove fill/vent screw. Wipe screw clean with a clean, lint-free cloth and reinstall - DO NOT THREAD INTO PUMP.
   - Remove fill/vent screw and note oil level. Oil level must be between the “ADD” and “FULL” marks on dipstick.
   - If necessary, add Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil through fill/vent screw hole to bring level up to “FULL” mark on dip stick. DO NOT OVERFILL.

NOTE: *In tropical areas, SAE 30 motor oil can be used.*



50473

a - Fill/Vent Screw
b - “FILL-ADD” Dipstick Markings Oildyne Power Trim Pump

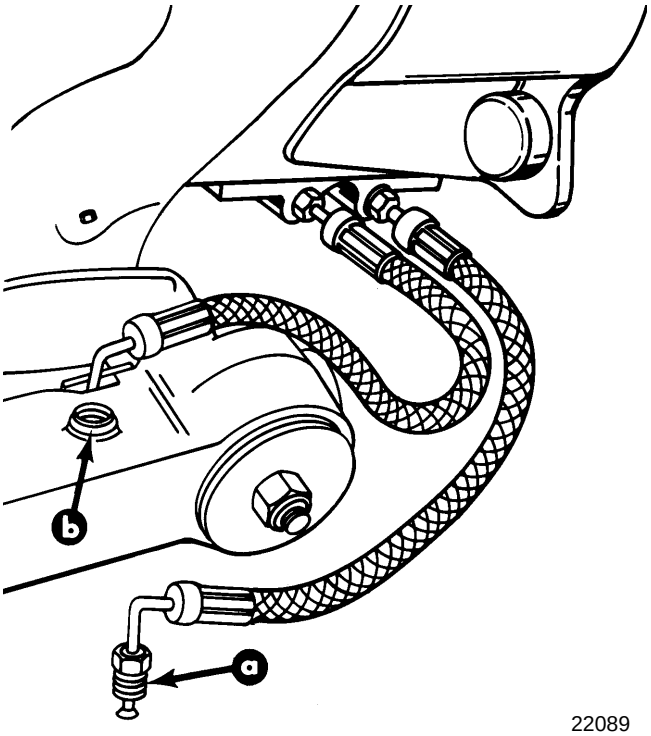
3. Raise and lower drive unit 2 times to purge air from system. Recheck oil level and add oil, if necessary.
4. Reinstall fill/vent screw by turning it all-the-way in. Back out screw one (1) full turn.

Air Bleeding Power Trim System

The Power Trim System will purge itself of a small amount of air by raising and lowering the drive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the following bleeding procedure should be used to remove the air from the system.

Bleeding OUT/UP Trim Circuit

1. Fill pump reservoir to proper level as explained preceding. (Trim cylinder must be compressed.)
2. Disconnect OUT/UP hose from front connection on trim cylinder. If both cylinders were rebuilt, disconnect hoses from both cylinders.
3. Direct end of trim hose(s) into a container.
4. Run trim pump in the UP direction until a solid, air-free stream of fluid is expelled from hose(s). Reconnect hose(s) and tighten securely.
5. Refill trim pump to proper level.



22089

a - OUT/UP Trim Hose
b - Front Connection on Trim Cylinder

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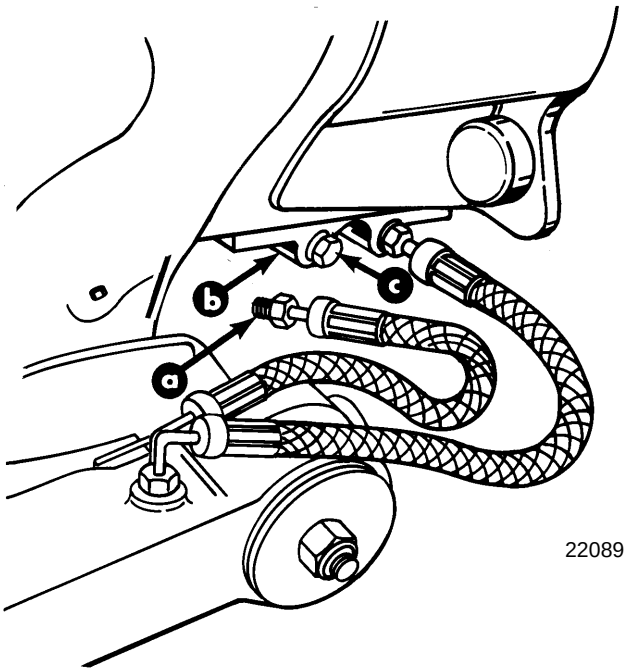
Bleeding IN/DOWN Trim Circuit

1. Ensure pump reservoir is filled to proper level.
2. Disconnect IN/DOWN hose from rear connection on gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect hoses from both sides of hydraulic connector.
3. Plug holes in hydraulic connector, using plug (22-38609) or suitable device.
4. Direct end of trim hose(s) into container.
5. Run trim pump in the UP direction until trim cylinders are fully extended.
6. Remove plug(s) from gimbal housing hydraulic connector and momentarily run trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from rear hole(s) in hydraulic connector. Reconnect trim hose(s) and tighten securely.
7. Lower drive unit to the full IN/DOWN position and refill trim pump to proper level. Run trim system IN/DOWN and OUT/UP several times and recheck fluid level.



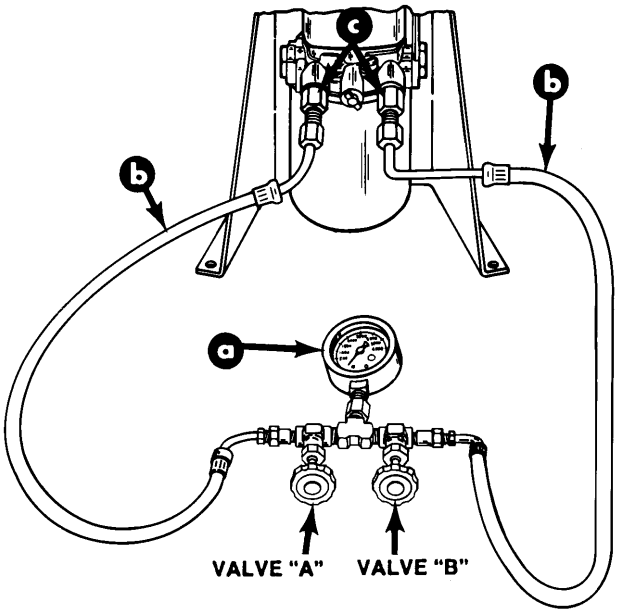
22089

a - IN/DOWN Trim Hose
b - Hydraulic Connector
c - Plug (22-38609)

Testing Power Trim Pump

Connecting Test Gauge

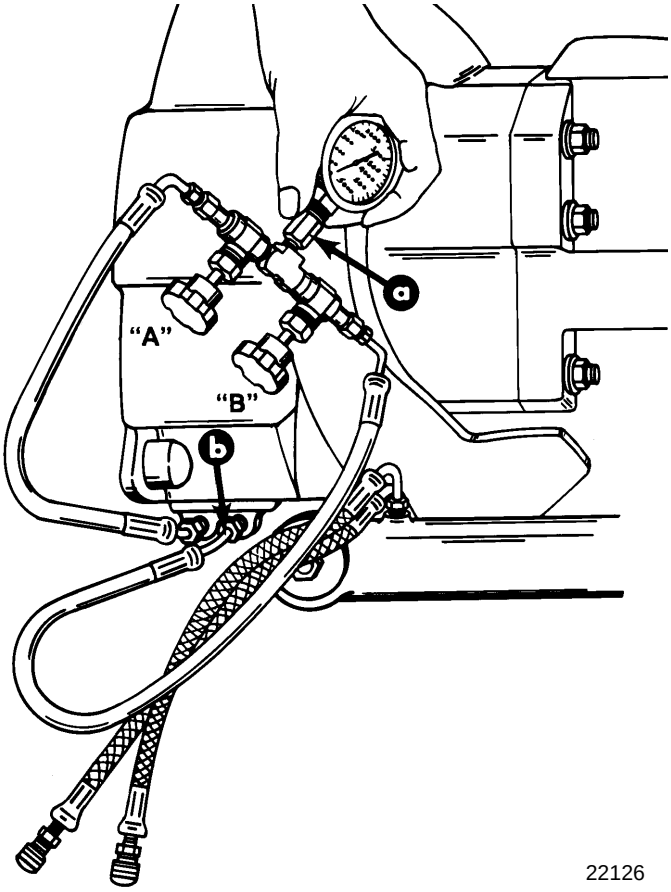
1. Check trim pump oil level. Fill if necessary.
2. Place drive unit in the full IN/DOWN position.
3. Connect test gauge at the most convenient location (at pump or hydraulic connector).



26349

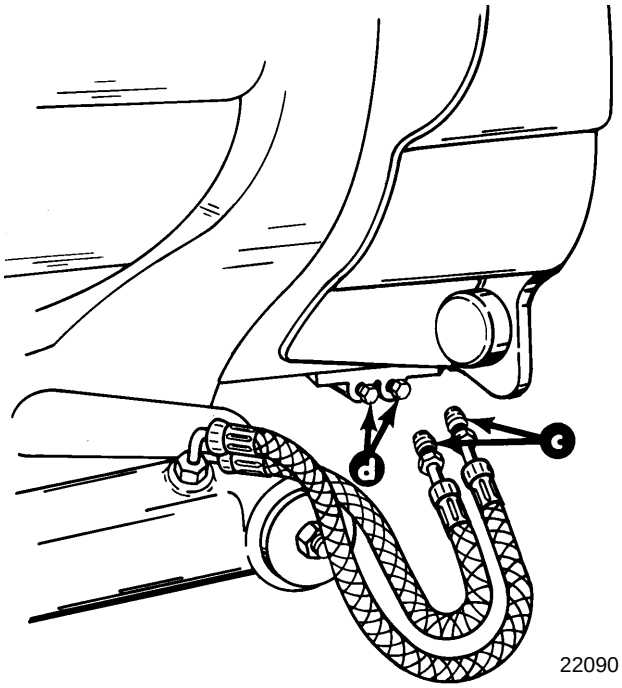
Gauge Connected to Pump

a - Hydraulic Test Gauge (91-52915A6)
b - Extension Hoses (91-52915A3)
c - Fittings (22-77366)



22126

a - Hydraulic Test Gauge (91-52915A3)
b - Gimbal Housing Hydraulic Connector



22090

Gauge Connect to Hydraulic Connector

c - Caps
d - Plugs

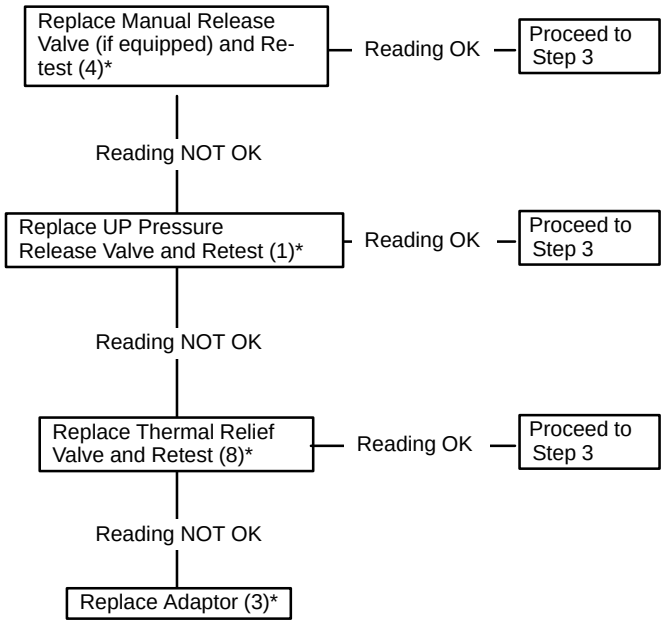
4. Open Valve "A" and "B" and run pump UP and DOWN several times (to purge air).

Internal Restriction Test

1. Open valve "A" and "B."
2. Run pump OUT/UP and IN/DOWN while observing gauge.
3. Replace adaptor, if pressure is in excess of 200 psi (1379 kPa).

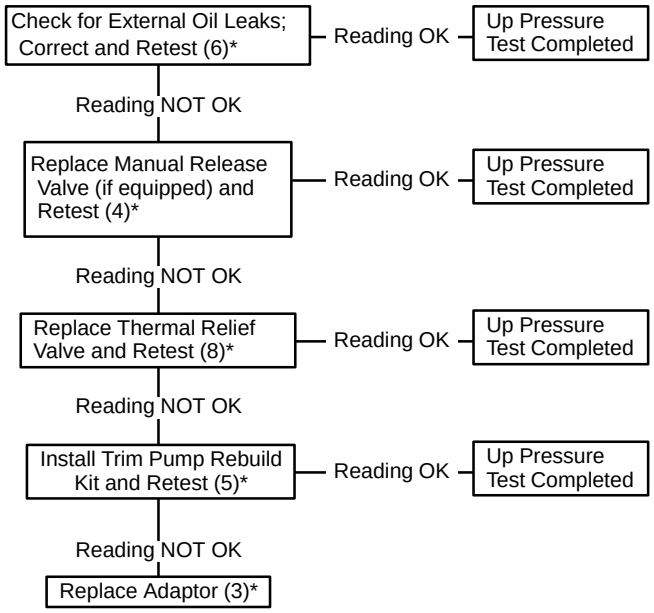
OUT/UP Pressure Test

1. Leave Valve "A" open and close Valve "B."
2. Run pump OUT/UP while observing gauge. Reading should be 2200 - 2600 psi (15173 - 17932 kPa).
   - **Gauge Reading Within Specifications,** proceed to step 3.
   - **Gauge Reading NOT Within Specifications,** perform the following:


Replace Manual Release Valve (if equipped) and Retest (4)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace UP Pressure Release Valve and Retest (1)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Thermal Relief Valve and Retest (8)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Adaptor (3)*

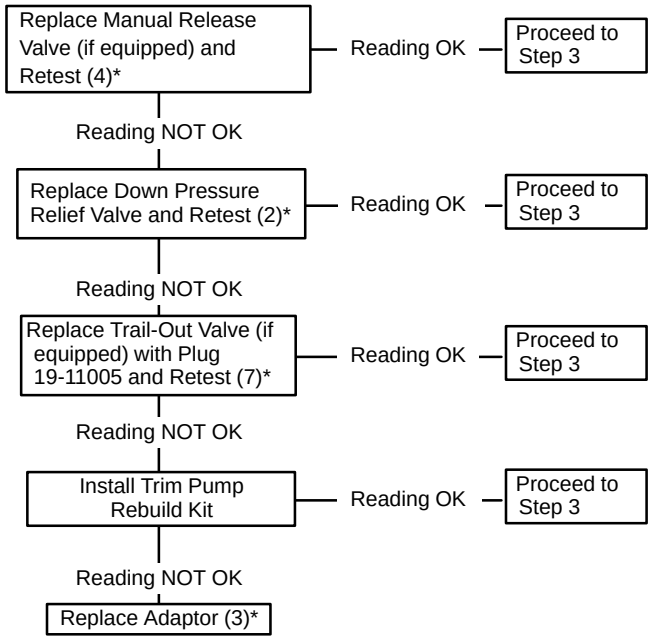
*The callout numbers refer to the callouts in drawing 73552

3. Run pump OUT/UP until gauge reading reaches 2200 - 2600 psi (15173 - 17932 kPa). Stop pumping UP. Pressure should not fall below 1900 psi (13104 kPa).
   - **Gauge Reading NOT Below 1900 PSI (13104 kPa),** UP Pressure Test completed.
   - **Gauge Reading Below 1900 PSI (13104 kPa),** perform the following:

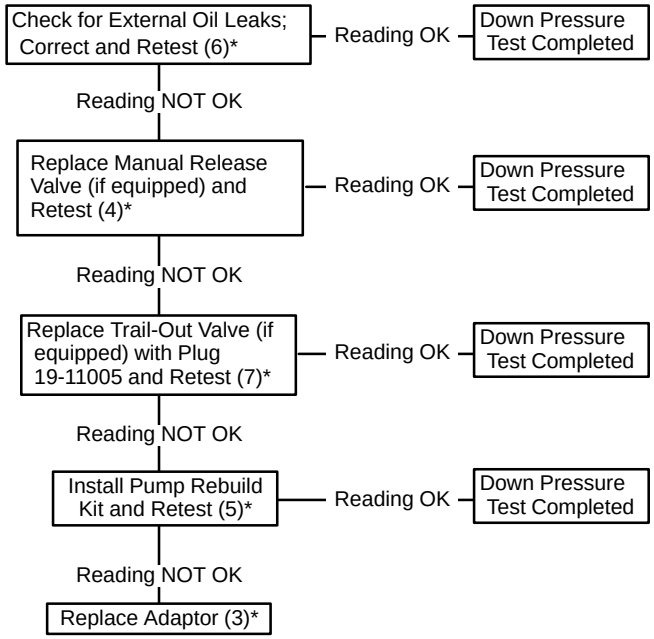

Check for External Oil Leaks; Correct and Retest (6)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Manual Release Valve (if equipped) and Retest (4)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Thermal Relief Valve and Retest (8)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Install Trim Pump Rebuild Kit and Retest (5)*
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Adaptor (3)*

IN/DOWN Pressure Test

1. Close Valve “A” and open Valve “B.”
2. Run Pump IN/DOWN while observing gauge. Reading should be 400 - 600 psi (2759 - 4138 kPa).
   - **Gauge Reading Within Specifications,** proceed to step 3.
   - **Gauge Reading NOT Within Specifications,** perform the following.


Replace Manual Release Valve (if equipped) and Retest (4)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Down Pressure Relief Valve and Retest (2)*
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Trail-Out Valve (if equipped) with Plug 19-11005 and Retest (7)*
Reading OK
Proceed to Step 3
Reading NOT OK
Install Trim Pump Rebuild Kit
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Adaptor (3)*

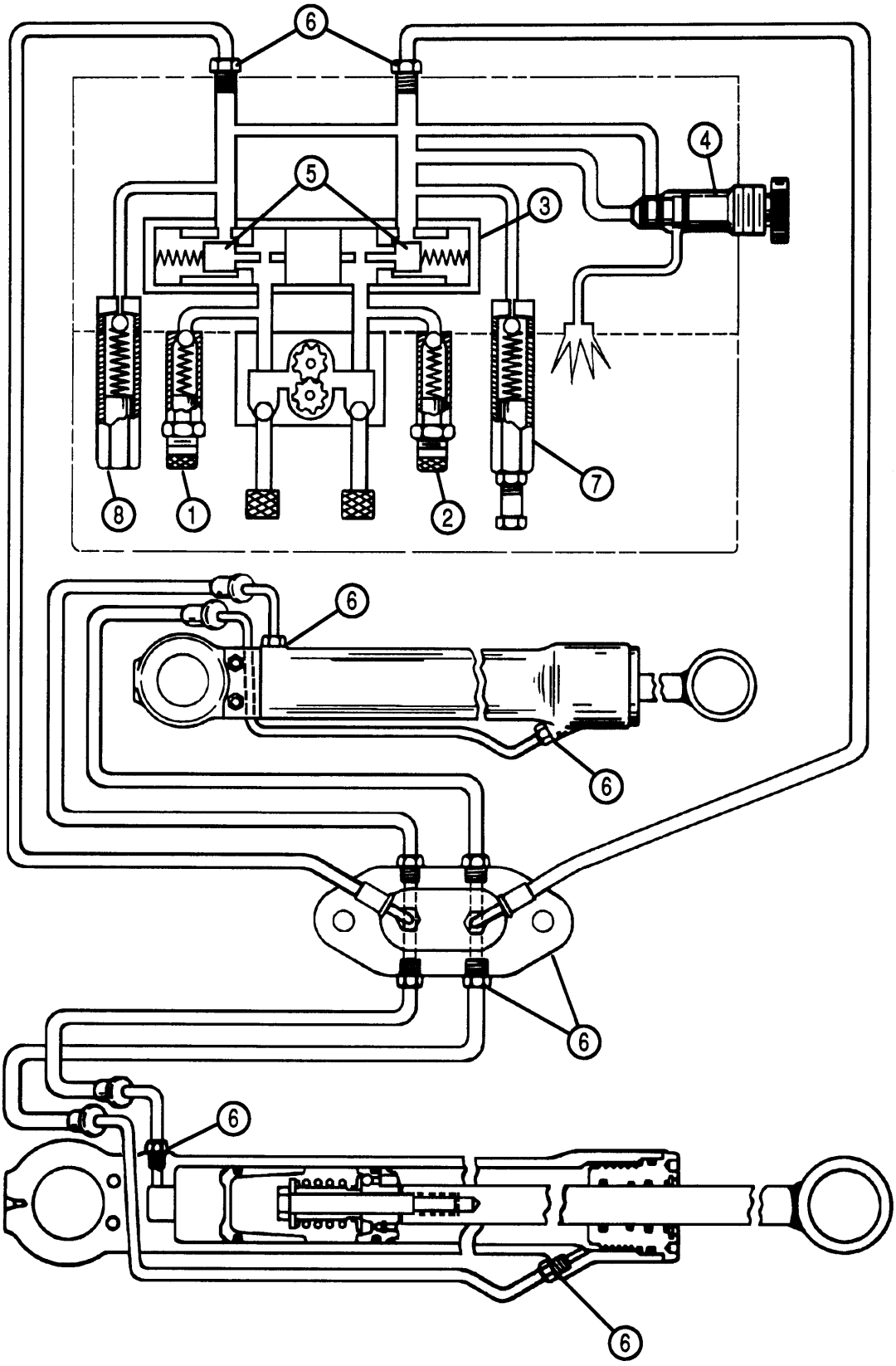
3. Run pump IN/DOWN until gauge reading reaches 400 - 600 psi (2759 - 4138 kPa). Stop pumping IN/DOWN. Pressure should not fall below 350 psi (2414 kPa).
   - **Gauge Reading Above 350 PSI (2414 kPa),** DOWN Pressure Test completed.
   - **Gauge Reading Below 350 PSI (2414 kPa),** perform the following:


Check for External Oil Leaks; Correct and Retest (6)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Replace Manual Release Valve (if equipped) and Retest (4)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Replace Trail-Out Valve (if equipped) with Plug 19-11005 and Retest (7)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Install Pump Rebuild Kit and Retest (5)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Replace Adaptor (3)*

*The callout numbers refer to the Trim Pump Hydraulic System drawing on p. 5B-8.

Trim Pump Hydraulic System

1 - IN/OUT Pressure Relief Valve
2 - IN/DOWN Pressure Relief Valve
3 - Adaptor
4 - Manual Relief Valve
5 - Check Valves
6 - Fittings
7 - Trail Out Valve
8 - Thermal Relief Valve

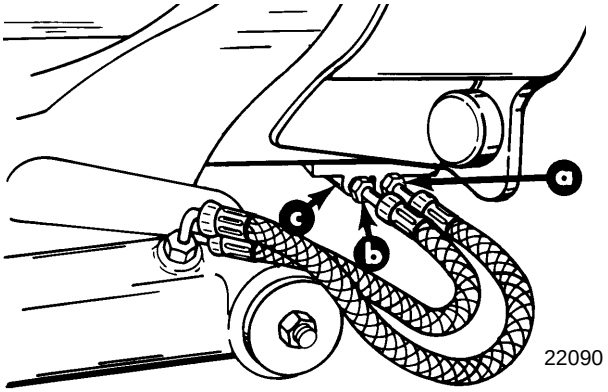


73890

Trim Cylinder Internal Leak Test

IMPORTANT: The following test assumes that pump OUT/UP pressure is within specifications as determined by performing "Power Trim Pump Test."

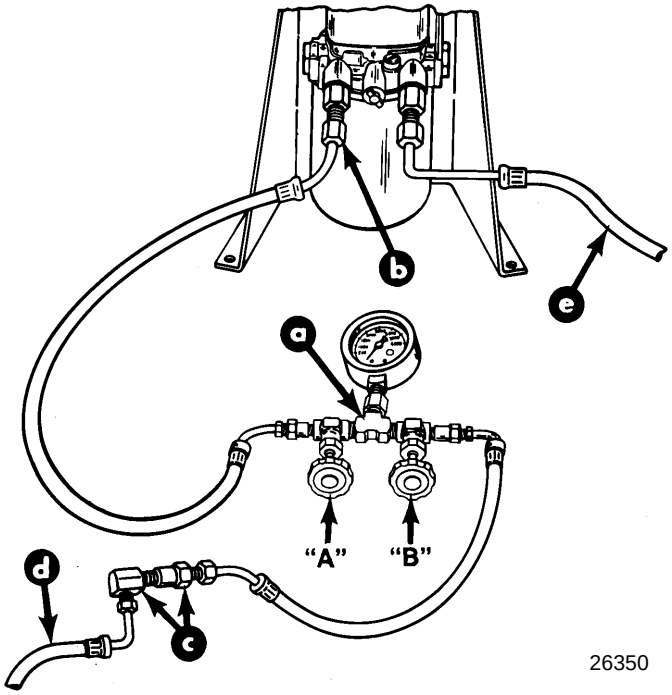
1. Reconnect trim cylinder hoses (if removed in previous test) as follows:
   a. Remove plugs and caps.
   b. Install UP hose to forward hole on hydraulic connector. Tighten securely.
   c. Install DOWN hose to aft hole on hydraulic connector. Tighten securely.



22090

a - UP Hose
b - DOWN Hose
c - Hydraulic Connector

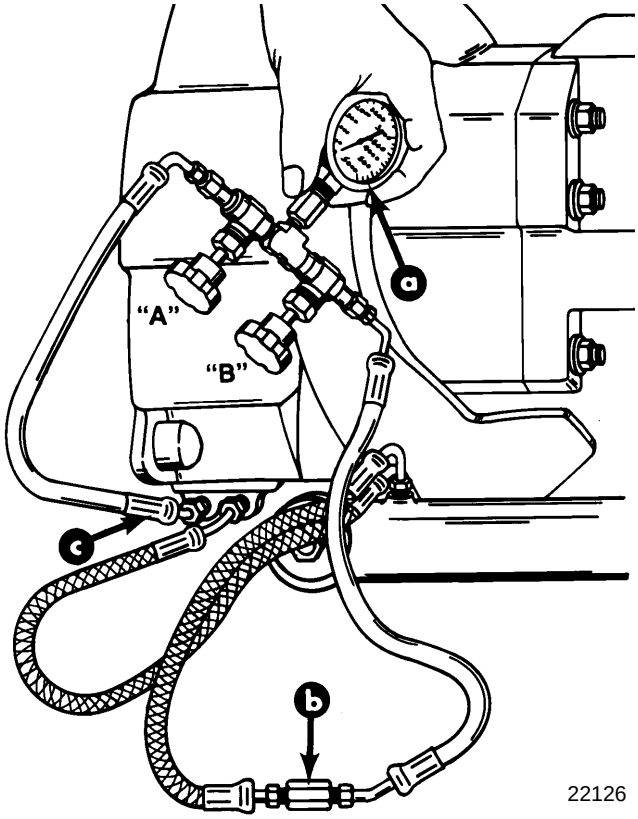
2. Connect gauge at most convenient location.



26350

Gauge Connected at Pump

a - Hydraulic Test Gauge (91-52915 A3)
b - Fitting (22-77366)
c - Fittings (Supplied with Gauge)
d - Black Hydraulic Hose (from Gimbal Housing)
e - Gray Hydraulic Hose (from Gimbal Housing)



22126

Gauge Connected to Hydraulic Connector

a - Test Gauge
b - Coupling (Supplied with Gauge)
c - Front Hydraulic Connector Port

3. Open Valve "A" and "B" and run pump OUT/UP and IN/DOWN; several times (to purge air).
4. Run pump OUT/UP until trim cylinders are fully extended. Observe gauge while pumping. Pressure should be 2200 - 2600 psi (15173 - 17932 kPa).
5. Stop pumping OUT/UP. Pressure should not fall below 1900 psi (13104 kPa).

   If readings are not within specifications, an internal trim cylinder leak is indicated. Use the following procedure to locate faulty cylinder.

   a. If gauge is connected at pump, reconnect gauge at gimbal housing hydraulic connector. Repeat Step 2. Run pump in OUT/UP direction until trim cylinder are fully extended.
   b. Close Valve "B" on test gauge and repeat Steps 3 and 4.

If Readings Are Now Within Specifications: Trim cylinder on the same side that test gauge is connected, is faulty.

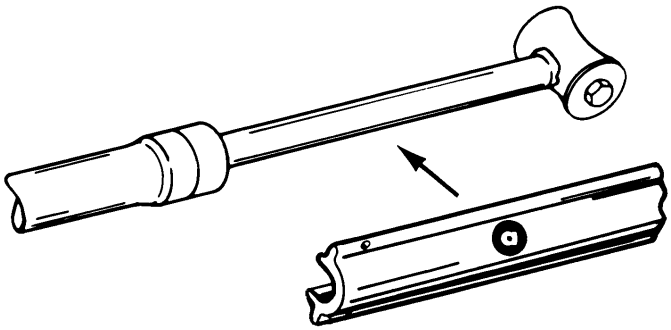
If Readings Are Still Not Within Specifications: Trim cylinder on the opposite side from where the test gauge is connected, is faulty.

Index

Trim Cylinder Shock Piston Test

If trim system checks out good, but drive unit will not trim IN/DOWN, problem may be due to a leaky trim cylinder shock piston. Use the following test to check for this condition. Test gauge is not required.

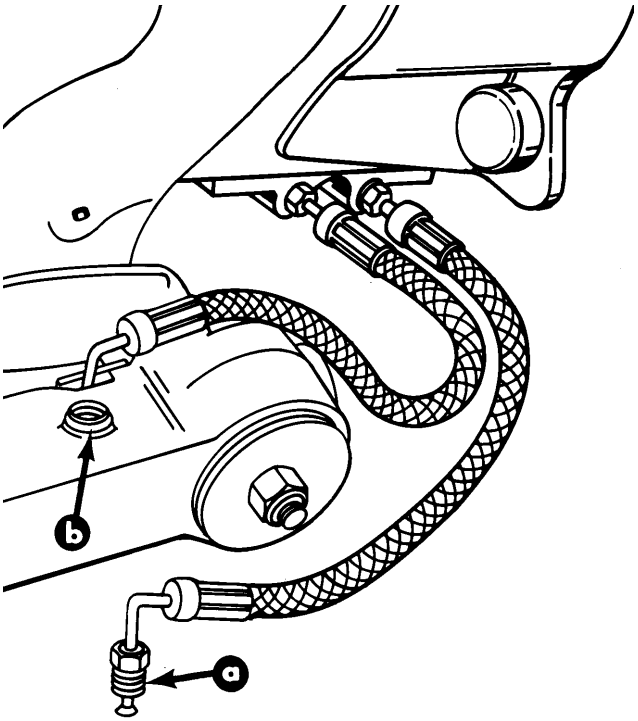
1. Run pump in OUT/UP direction until trim cylinders are fully extended.
2. Prevent trim cylinder piston rods from retracting, using a suitable device. Quicksilver Trailering Kit works well for this purpose.



22562

a - Trailering Clip

3. Disconnect UP trim hose from trim cylinders.



22089

a - UP Trim Hose
b - Front Connection

4. Run pump in IN/DOWN direction. If oil flows from UP port on trim cylinder, shock piston is leaking and must be replaced.

Motor and Electrical Bench Tests

Trim Pump Motor Test (In Boat)

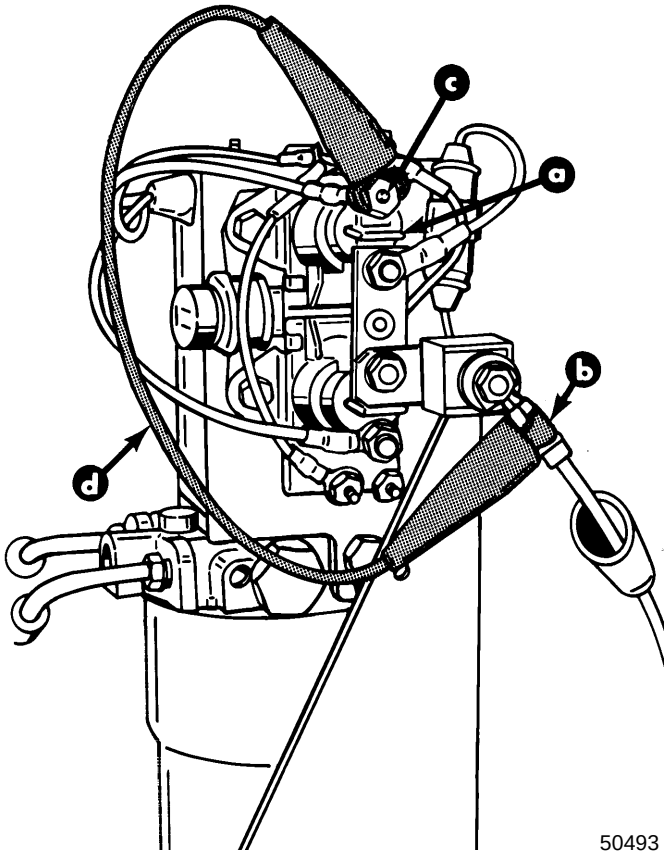
⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

⚠WARNING

Remain clear of drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

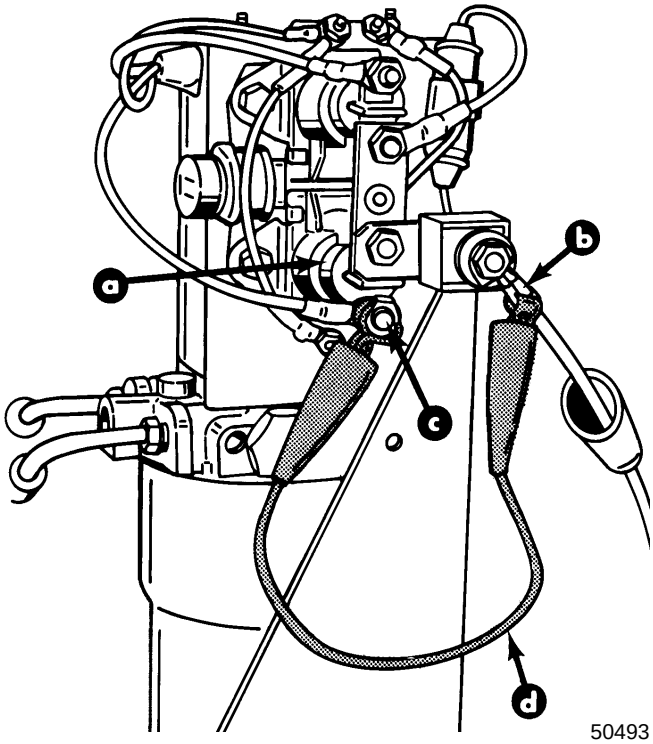
1. OUT/UP Operation:
   a. Connect a jumper wire between positive (+) solenoid terminal and BLUE/WHITE motor lead terminal.
   b. Motor should run.



50493

a - OUT/UP Solenoid
b - Positive Terminal (+)
c - Blue-White Motor Lead Terminal
d - Jumper Wire

2. IN/DOWN Operation:
   a. Connect a jumper wire between positive (+) solenoid terminal and green-white motor lead terminal.
   b. Motor should run.



50493

a - IN/DOWN Solenoid
b - Positive Terminal (+)
c - Green-White Motor Lead Terminal
d - Jumper Wire

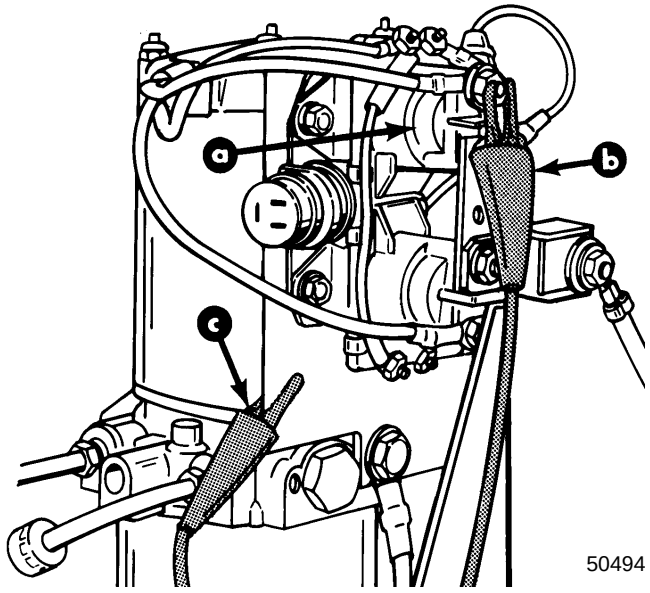
3. If motor does not run, refer to “Motor Repair.” See Table of Contents.

Trim Pump Motor Test (Out of Boat)

⚠ WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

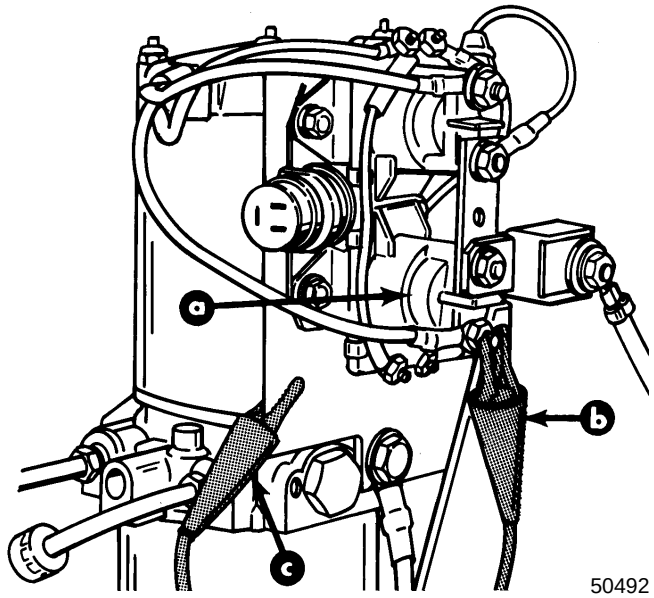
1. Remove trim pump from boat. Refer to “Trim Pump Removal.” See Table of Contents.
2. Remove fluid from trim pump reservoir.
3. OUT/UP Operation:
   a. Connect a 12 volt positive (+) supply lead to BLUE/WHITE motor lead terminal.
   b. Connect the negative (-) supply lead to a good ground on pump.
   c. Motor should run.



50494

a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead

4. IN/DOWN Operation:
   a. Connect a 12 volt positive (+) supply lead to green-white motor lead terminal.
   b. Connect the negative (-) supply lead to a good ground on pump.
   c. Motor should run.



50492

a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead

5. If motor does not run, refer to “Motor Repair.” See Table of Contents.

Solenoid Test (Pump in Boat)

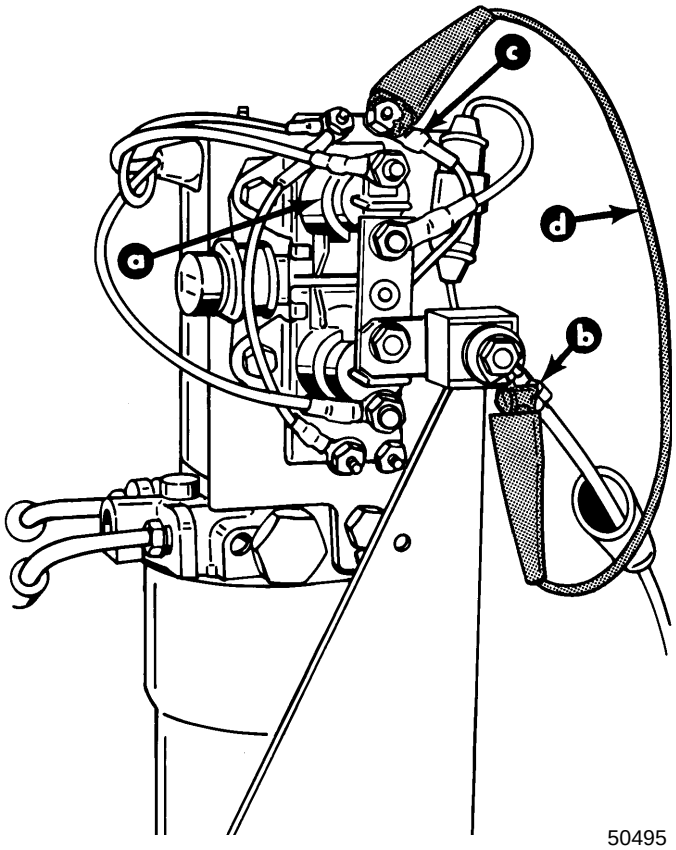
⚠ WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

⚠ CAUTION

Remain clear of drive unit when performing power trim pump motor tests with pump in boat and hydraulic hose connected.

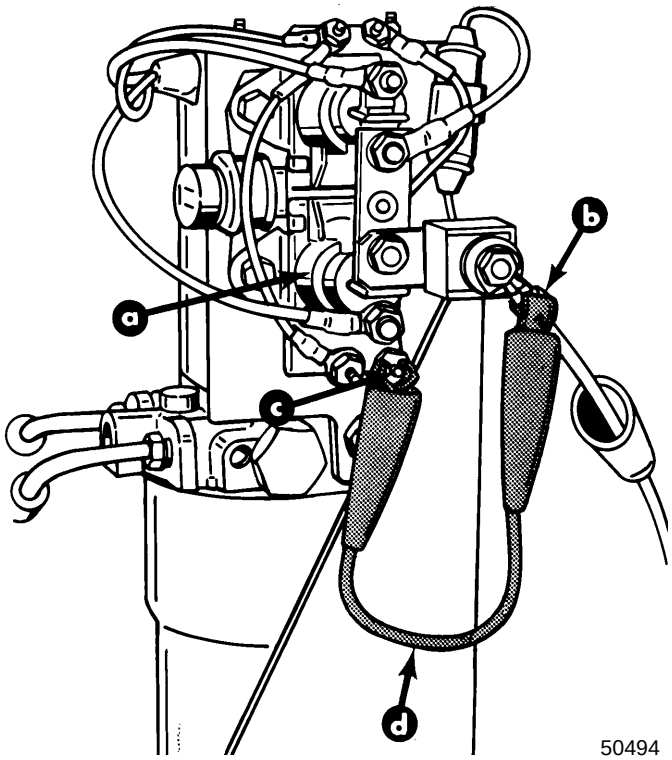
1. UP/"Out" Solenoid:
   a. Connect jumper wire between positive (+) solenoid terminal and BLUE/WHITE harness wire terminal.
   b. Motor should run.



50495

a - OUT/UP Solenoid
b - POSITIVE (+) Terminal
c - BLUE/WHITE Harness Wire Terminal
d - Jumper Wire

2. IN/DOWN Solenoid:
   a. Connect a jumper wire between positive (+) solenoid terminal and green-white harness wire terminal.
   b. Motor should run.



50494

a - IN/DOWN Solenoid
b - POSITIVE (+) Terminal
c - GREEN/WHITE Harness Wire Terminal
d - Jumper Wire

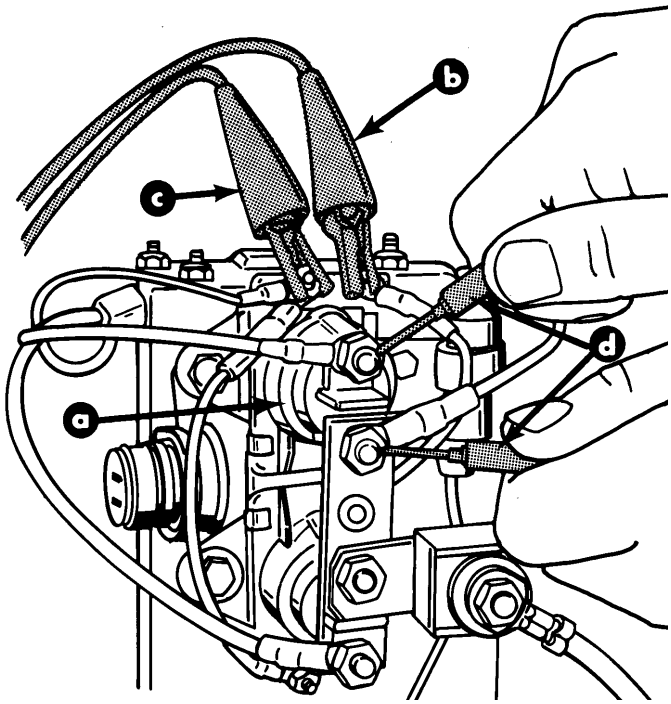
3. If motor does not run in one direction or another, replace appropriate solenoid. (See Wiring Diagram at end of this section for wire connection points.)

Solenoid Test (Pump Out of Boat)

⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

1. Remove trim pump from boat. Refer to “Trim Pump Removal.” See Table of Contents.
2. Remove fluid from trim pump reservoir.
3. OUT/UP Solenoid:
   a. Connect 12 volt positive (+) supply lead to BLUE/WHITE harness wire terminal.
   b. Connect negative (-) supply lead to solenoid ground terminal.
   c. Connect ohmmeter leads to large terminals on solenoid.



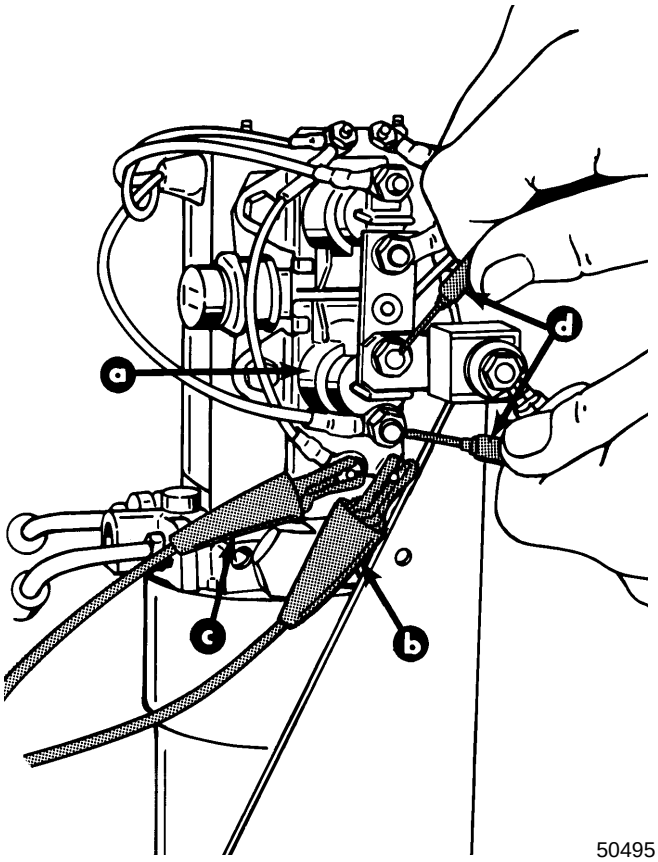
50492

a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead
d - Ohmmeter Leads

4. **Zero Ohms Reading** (Full Continuity) - Solenoid is OK.

   High Ohms Reading (No Continuity) - Replace solenoid.

5. IN/DOWN Solenoid:
   a. Connect 12 volt positive (+) supply lead to green-white harness wire terminal.
   b. Connect negative (-) supply lead to solenoid ground terminal.
   c. Connect ohmmeter leads to large terminals on solenoid.



50495

a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead
d - Ohmmeter Leads

6. **Zero Ohms Reading** (Full Continuity) - Solenoid is OK.
   High Ohms Reading (No Continuity) - Replace solenoid.

See Wiring Diagram at the end of this section for wiring connection points.

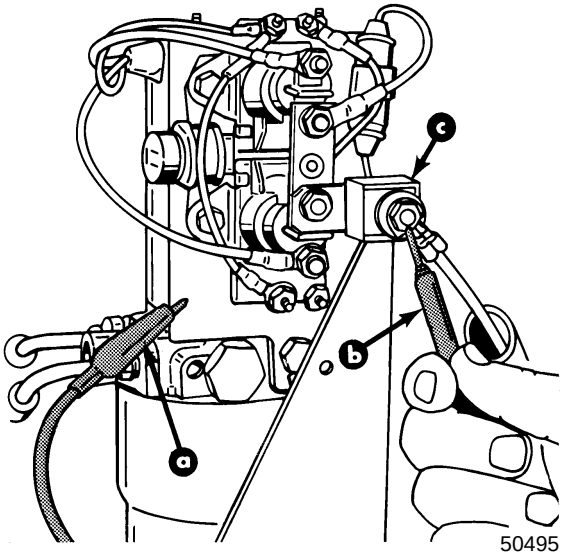
110 Amp Fuse Test (Pump in Boat)

⚠WARNING

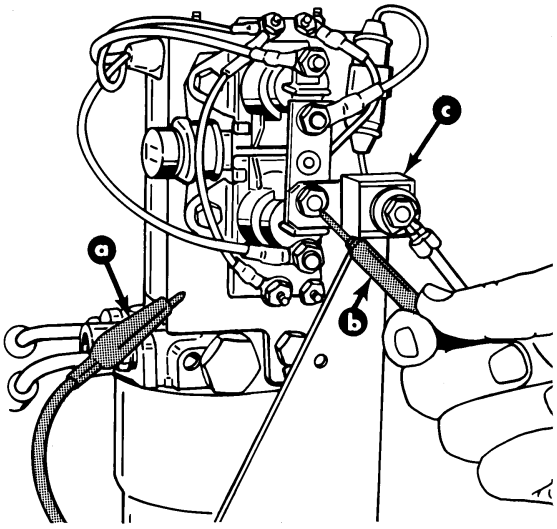
DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

1. Check for voltage at terminal “1” using a volt meter. Voltage MUST BE indicated before proceeding with next check.
2. Check for voltage at terminal “2”, using volt meter.

Voltage Indicated: Fuse OK.
Voltage Not Indicated: Replace fuse.



50495



50494

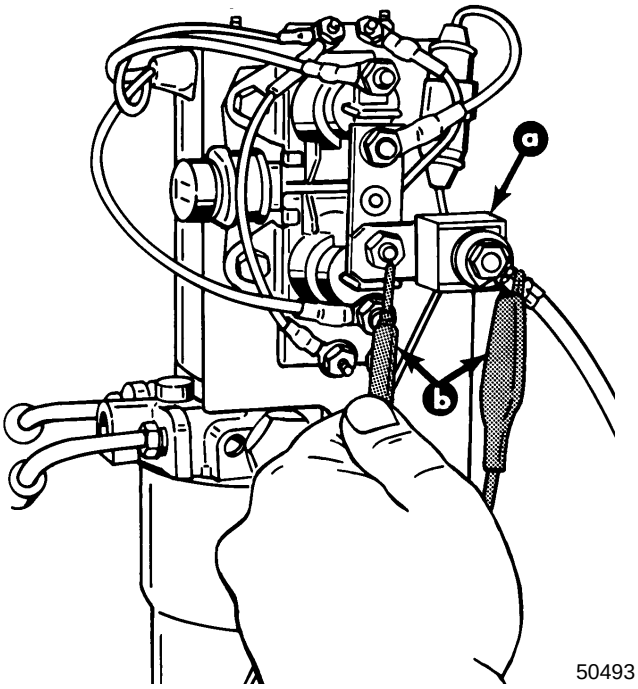
a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse

110 Amp Fuse Test (Pump Out Of Boat)

1. Connect ohmmeter leads between terminals on fuse.

Zero Ohms Reading (Full Continuity) - Fuse OK.

High Ohms Reading (No Continuity) - Replace fuse.

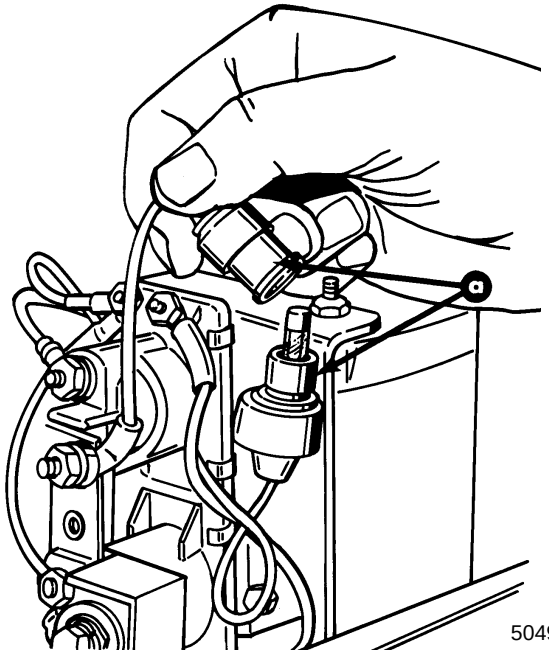


50493

a - 110 Amp Fuse
b - Ohmmeter Leads

20 Amp Fuse Test (If Equipped)

1. Remove fuse from fuse holder.



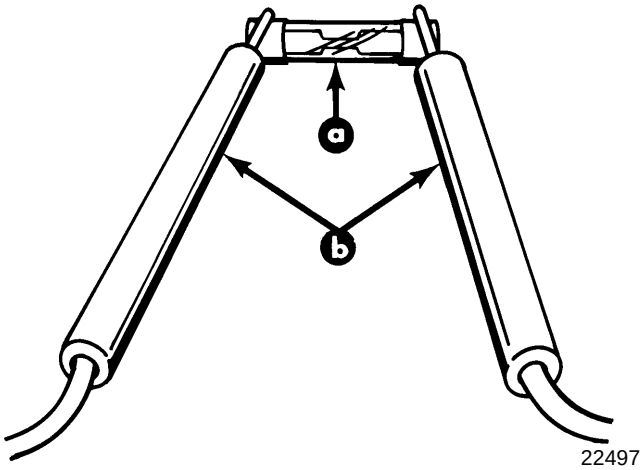
50492

a - Fuse Holder

2. Connect ohmmeter; one lead to each end of fuse.

Zero Ohms Reading (Full Continuity) - Fuse OK.

High Ohms Reading (No Continuity) - Replace fuse.



22497

a - 20 Amp Fuse
b - Ohmmeter Leads

20 Amp Circuit Breaker Test - (If Equipped)

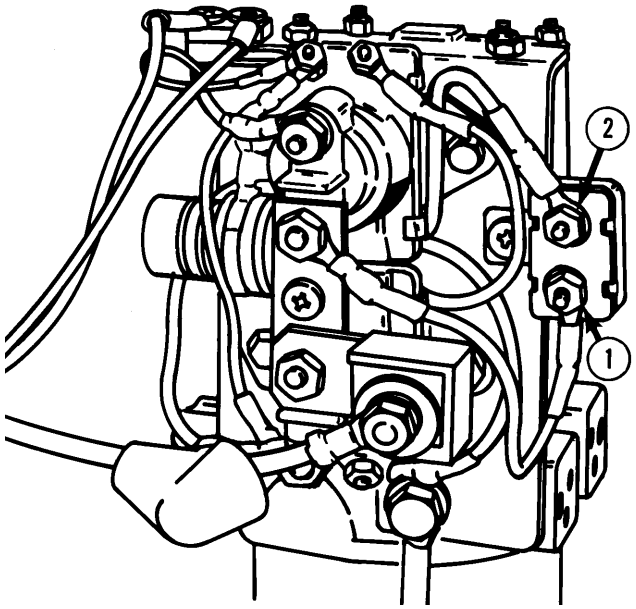
1. Check that reset tab is pushed in.

   Check for voltage at terminal “1”, using a voltmeter. Voltage MUST BE indicated before proceeding with next check.

   Check for voltage at terminal “2”, using a voltmeter.

   - **Voltage Indicated:** Breaker OK.

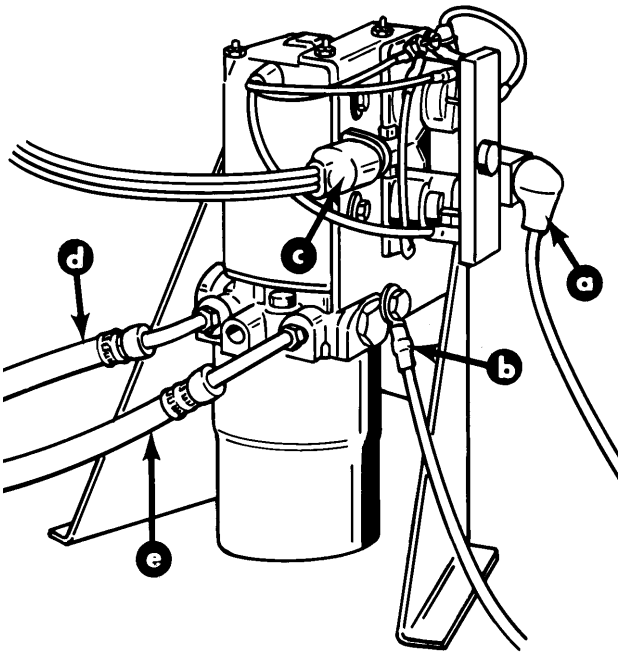
   - **Voltage NOT Indicated:** Replace breaker.



50476

Trim Pump Removal

1. Disconnect trim pump battery leads from battery (negative lead first).
2. Disconnect trim harness connector (3 pronged) from trim pump.
3. Remove hydraulic hoses from trim pump. Cap end of hoses.
4. Remove lag bolts and washer. Lift pump and floor bracket from boat.



50494

a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)

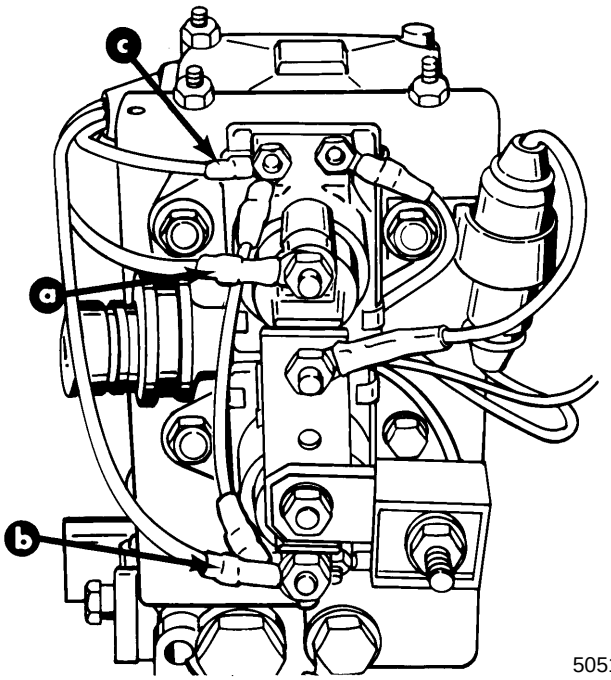
Hydraulic Repair

Disassembly

⚠CAUTION

Work area must be dirt-and-lint free. The slightest amount of dirt in hydraulic system can cause pump malfunction.

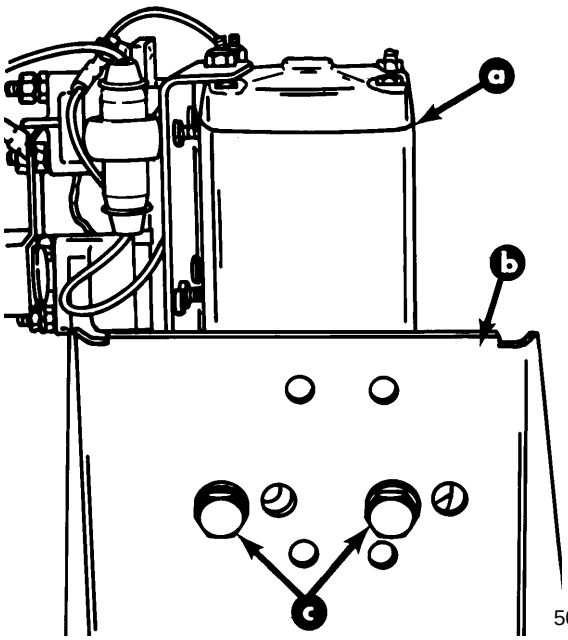
1. Disconnect trim motor wires.



50512

a - Blue/White Motor Wire
b - Green/White Motor Wire
c - Black Ground Wire

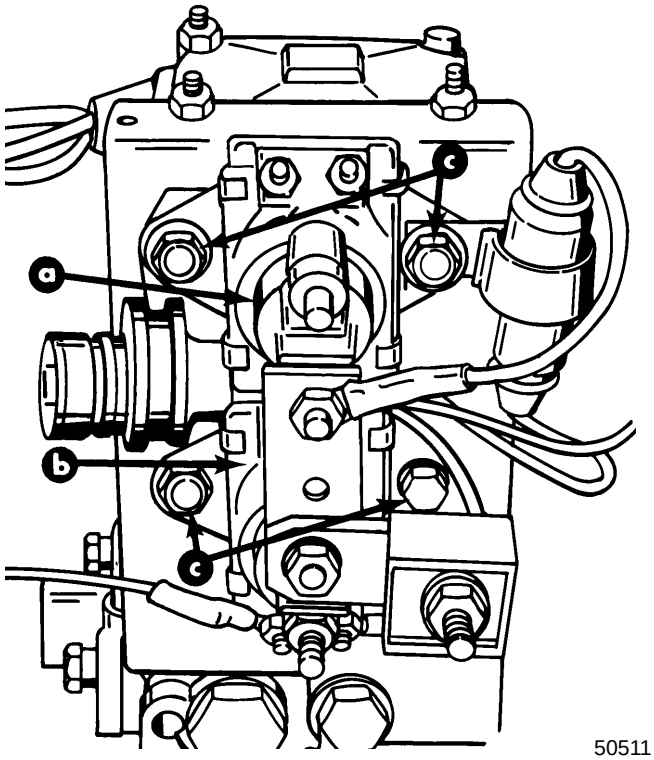
2. Remove mounting bolts and remove trim pump from floor bracket.



50509

a - Trim Pump
b - Floor Bracket
c - Mounting Bolts

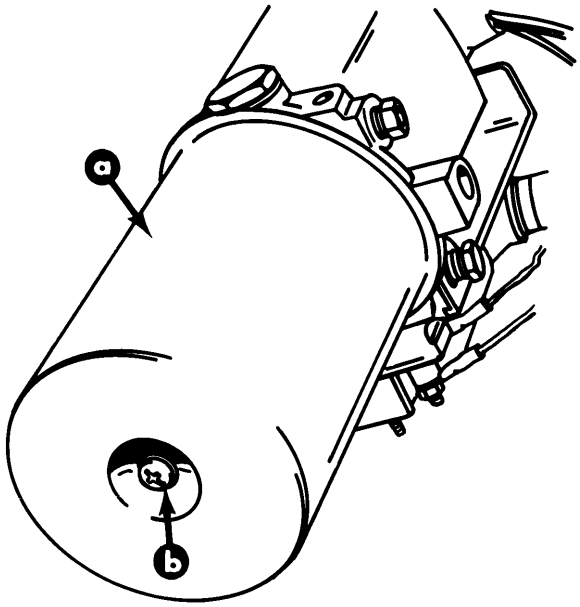
3. Remove solenoids (if replacement is necessary).



50511

a - UP Solenoid
b - DOWN Solenoid
c - Mounting Bolts (2 on Each Solenoid)

4. Remove pump reservoir.



50509

a - Pump Reservoir
b - Bolt and O-ring

Index

Manual Release Valve Replacement (If Equipped)

NOTE: *Refer to "Special Information."*

NOTE: *Replacement of manual release valve can be completed without removing the trim pump from boat.*

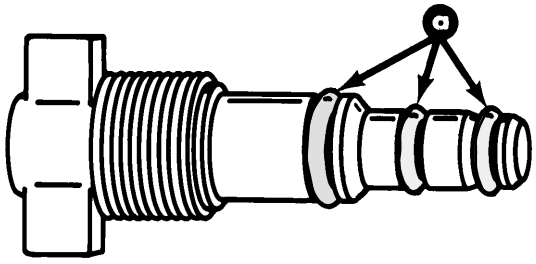
O-ring damage may result from the following:

- Operation of the Power Trim pump with the "Manual Release Valve" partially open. **Valve Must Be Completely Closed (Turned Clockwise Until Bottomed-Out) When Trimming IN/DOWN or OUT/UP** Tighten valve finger-tight only - DO NOT USE A PLIERS.
- Opening "Manual Release Valve" quickly with sterndrive unit in the fully raised position. **Valve Must Be Opened SLOWLY to Gradually Relieve Pressure On System.**
- Continuous use of "Manual Release Valve." **Valve Is Designed for Emergency (Limited) Use Only.**

⚠ WARNING

Before loosening the manual release valve, make sure all people are clear of drive unit as drive unit will drop to full IN/DOWN position when valve is loosened.

1. Inspect manual release valve for damaged O-rings and replace valve if necessary.
2. Slowly turn manual release valve counterclockwise to remove. To install new valve, turn valve clockwise until it seats.



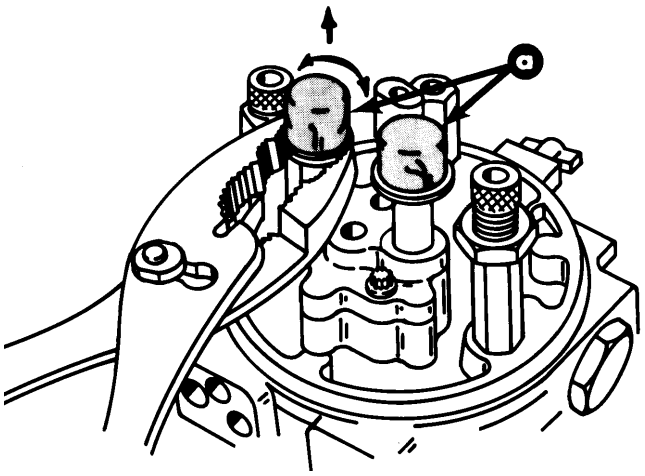
50473

a - O-rings (3)

NOTE: *Some valves have only two O-rings. Order replacement valve with the same number of O-rings as the original valve.*

Filter Replacement

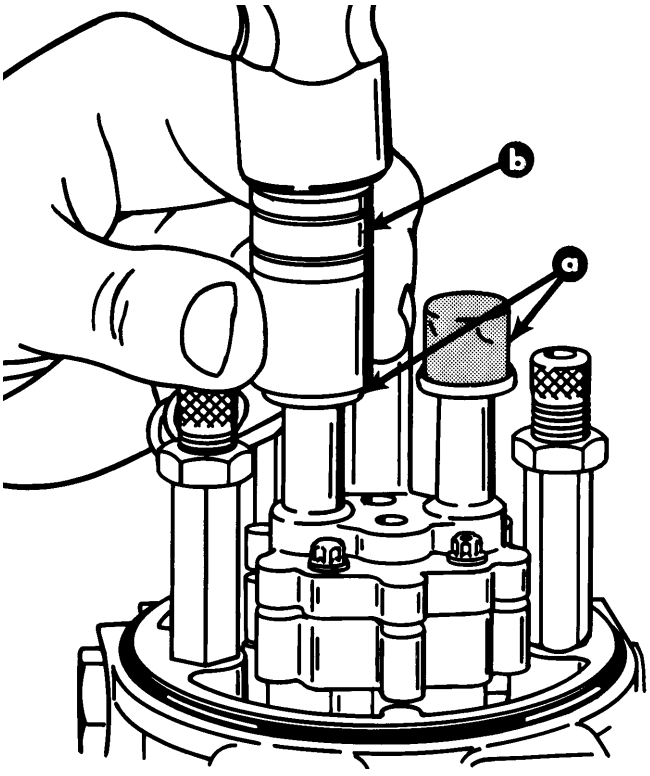
1. Remove filter by twisting while pulling upward.



50473

a - Filters

2. Install new filters.

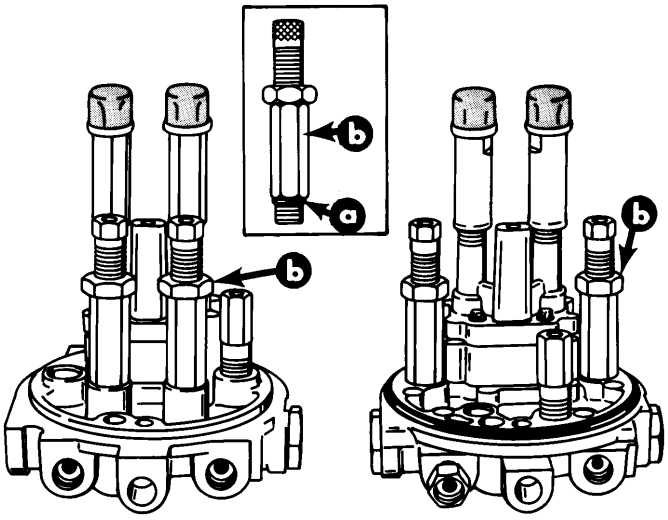


50472

a - Filters
b - 5/8 In. Socket

UP Pressure Relief Valve Replacement

NOTE: *UP pressure relief valve in kit is color coded blue for easy identification.*



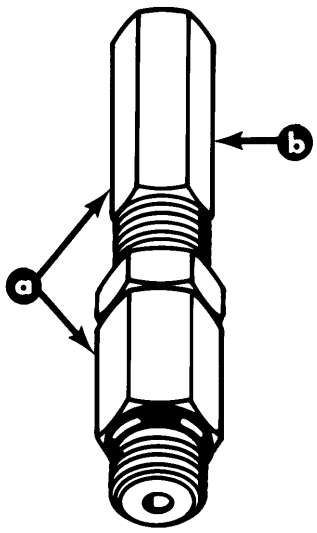
NEW ADAPTOR **OLD ADAPTOR**

50474

a - O-ring
b - UP Pressure Relief Valve

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen nor attempt to remove hex "jam" nut. This valve is preset at the factory for proper UP pressure relief.

NOTE: *Original factory installed pressure relief valves will be a natural steel finish - they will NOT be color coded.*



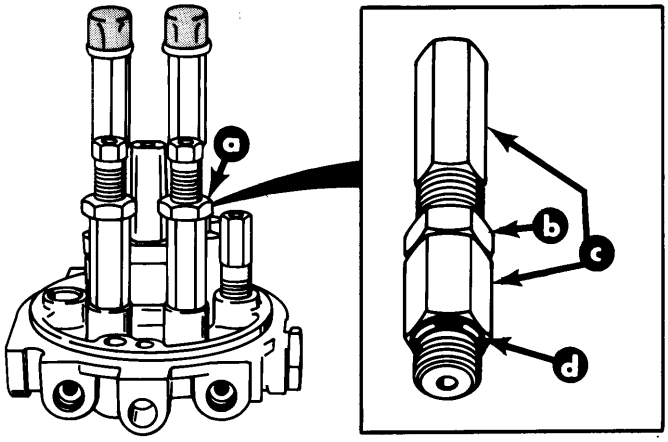
50396

CURRENT REPLACEMENT PRESSURE RELIEF VALVE

a - Replacement UP Pressure Relief Valve
b - Color Coded Blue

1. Replace UP pressure relief valve. Ensure that threaded hole is free of dirt. Lubricate O-ring at base of new valves with Power Trim and Steering Fluid and install. Torque to 70 lb. in. (8 N·m).

IMPORTANT: DO NOT loosen or attempt to remove jam nut.

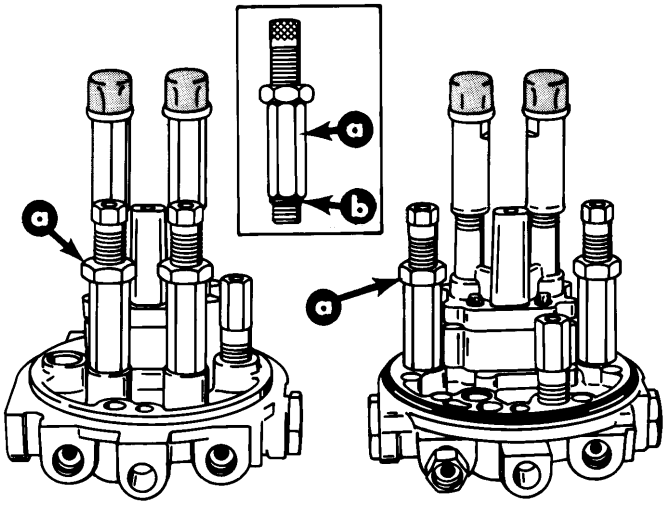


50474 50396

a - UP Pressure Relief Valve
b - Jam Nut
c - Replacement UP Pressure Relief Valve (Blue)
d - O-ring

DOWN Pressure Relief Valve Replacement

NOTE: *DOWN pressure relief valve in kit is color coded green for easy identification.*



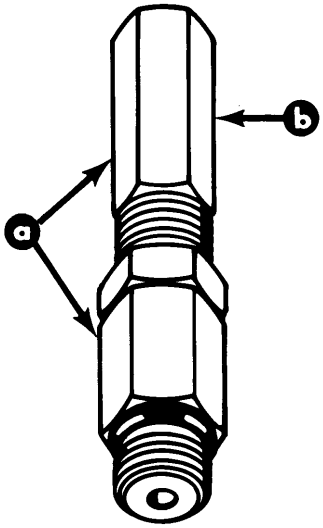
NEW ADAPTOR **OLD ADAPTOR**

50474

a - DOWN Pressure Relief Valve
b - O-ring

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen nor attempt to remove hex "jam" nut. This valve is preset at the factory for proper DOWN pressure relief.

NOTE: *Original factory installed pressure relief valves will be a natural steel finish - they will NOT be color coded.*

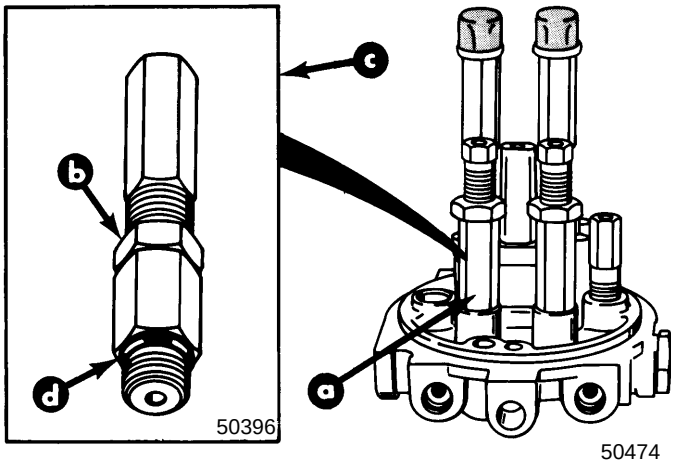


50396

Current Replacement Pressure Relief Valve

a - Replacement DOWN Pressure Relief Valve
b - Color Coded Green

1. Replace DOWN pressure relief valve. Ensure that threaded hole is free of dirt. Lubricate O-ring at base of new valve with Power Trim and Steering Fluid and install. Use base of replacement valve to tighten. Torque to 70 lb. in. (8 N·m).



50396

50474

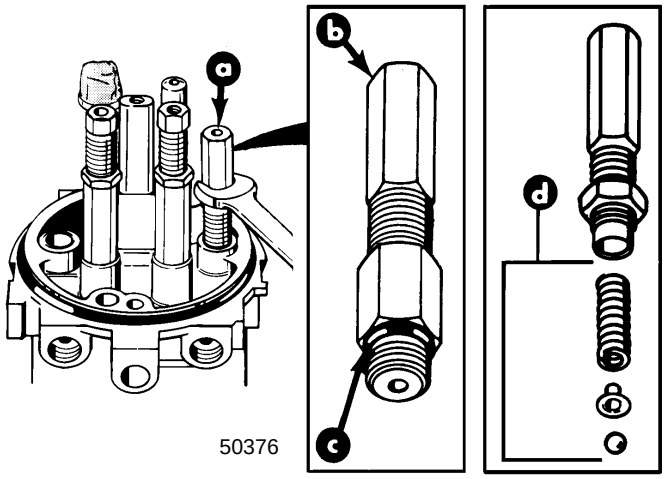
a - DOWN Pressure Relief Valve
b - Jam Nut
c - Replacement Valve (Green)
d - O-ring

Thermal Relief Valve Replacement

NOTE: *Thermal Relief Valve in kit is color coded gold for easy indentification.*

IMPORTANT: Thermal relief valve is factory preset. DO NOT loosen or attempt to separate component parts. Do not use wrench on upper gold colored fitting; tightening with wrench, must be on the lower hex-fitting of the replacement valve.

1. Replace thermal relief valve. Remove and discard spring, eyelet and checkball on earlier style valves. Ensure that threaded hole is free of dirt. Lubricate O-ring at base of new valve with Power Trim and Steering Fluid and install. Torque to 70 lb. in. (8 N·m).



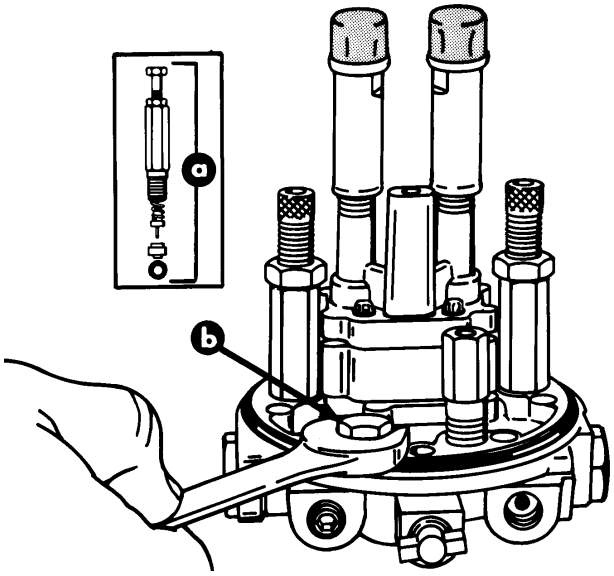
50376

a - Thermal Relief Valve
b - Replacement Thermal Relief Valve (Gold)
c - O-ring
d - Spring, Eyelet And Checkball On Earlier Style Valves

Replacement Plug - Trail-Out Valve

NOTE: *Refer to "Special Information" (See "Index").*

1. Remove and discard trail out valve assembly.
2. Install replacement plug with O-ring. Be sure that threaded valve hole is clean and free of foreign material.
3. Tighten replacement plug and O-ring securely.



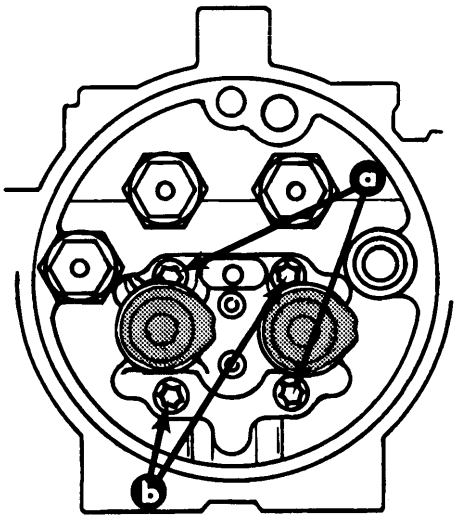
50472

a - Trail-Out Valve Assembly
b - Replacement Plug And O-ring

Pump Replacement

NOTE: *The pump is not rebuildable. If pump is defective, replace as an assembly.*

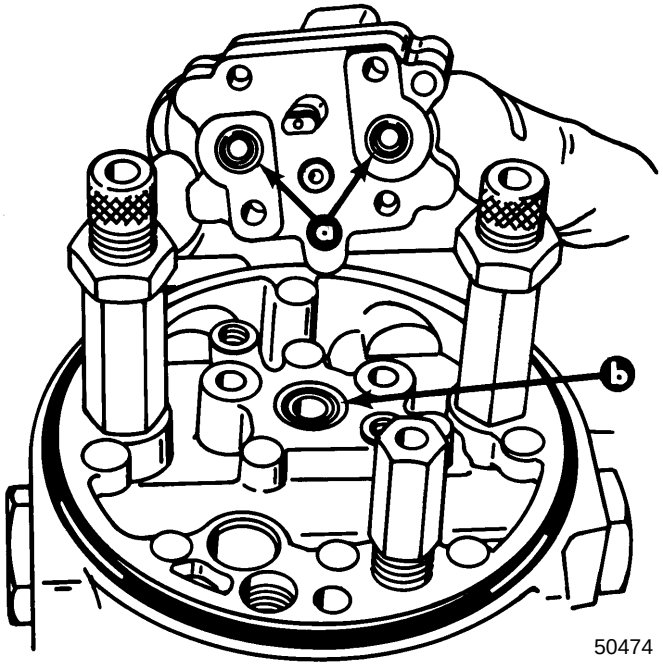
1. Remove pump attaching screws with a hex lobular socket or standard 3/16 in. socket. Do NOT loosen pump assembly screws. Remove pump.



70870

a - Screws
b - Pump Assembly Screws

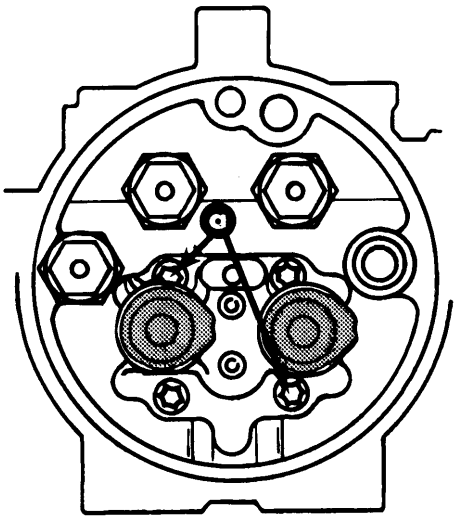
2. Remove O-rings from old pump and install on new pump.
3. Lubricate lip of adaptor seal with light weight oil.



50474

a - O-rings
b - Adaptor Seal

4. Install pump and torque screws to 70 lb. in. (8 N·m) using a hex lobular socket or standard 3/16 in. socket.



70870

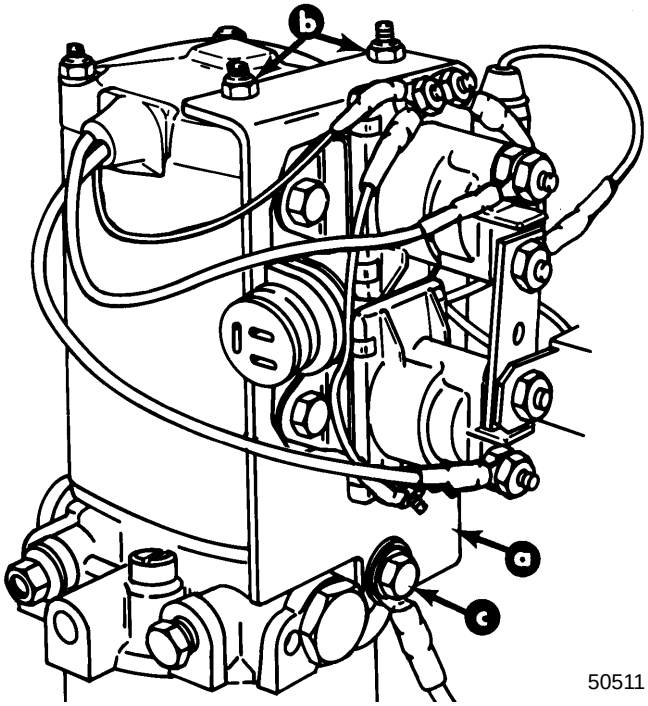
a - Screws

Adaptor Replacement

NOTE: *Adaptor is rebuildable (Refer to "Adaptor Repair"). Order "Trim Pump Adaptor Kit" (99073A1).*

1. Remove hydraulic lines from the adaptor and cap off the lines.

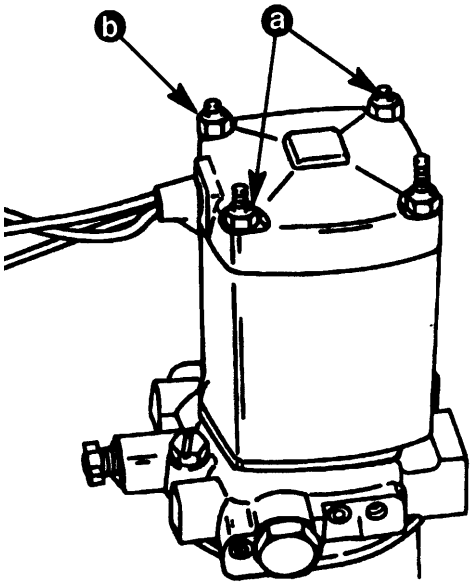
2. Remove solenoid plate.



50511

a - Solenoid Plate
b - Locknuts
c - Bolts

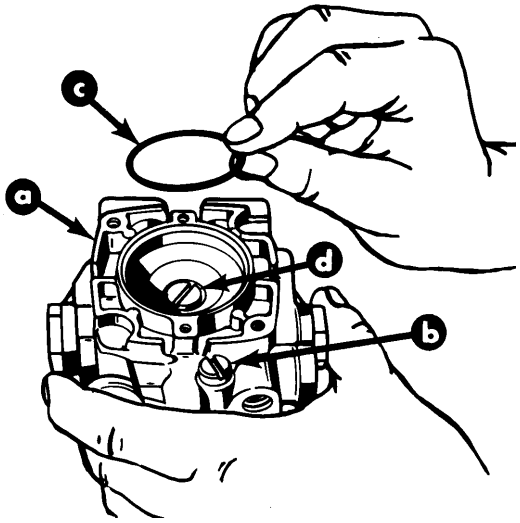
3. Remove 2 locknuts (a) shown in illustration. Remove motor assembly.



73885

a - Remove Locknuts (Studs May Turn Out)
b - DO NOT Loosen

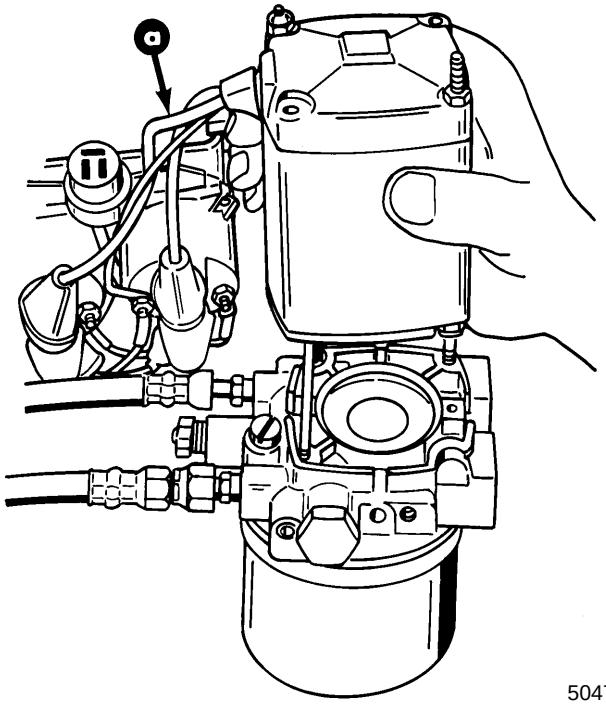
4. Remove and discard (motor to adaptor) O-ring).
5. Remove vent screw (dipstick) from old adaptor.
6. Remove reservoIr.
7. Install vent screw (dipstick) and new O-ring in new adaptor.
8. Install pump reservoir.
9. Ensure coupling is installed so that shallow slot is toward reservoir. Lubricate coupling with 2-4-C Marine Lubricant.



22498

a - Adaptor
b - Vent Screw (Dipstick)
c - O-ring
d - Coupling - (Shallow Slot Toward Reservoir)

10. Remove studs from old adaptor and install in new adaptor.
11. Align motor shaft with coupling and install motor onto adaptor. Be sure wires are positioned as shown below. Motor assembly will be flush with adaptor.

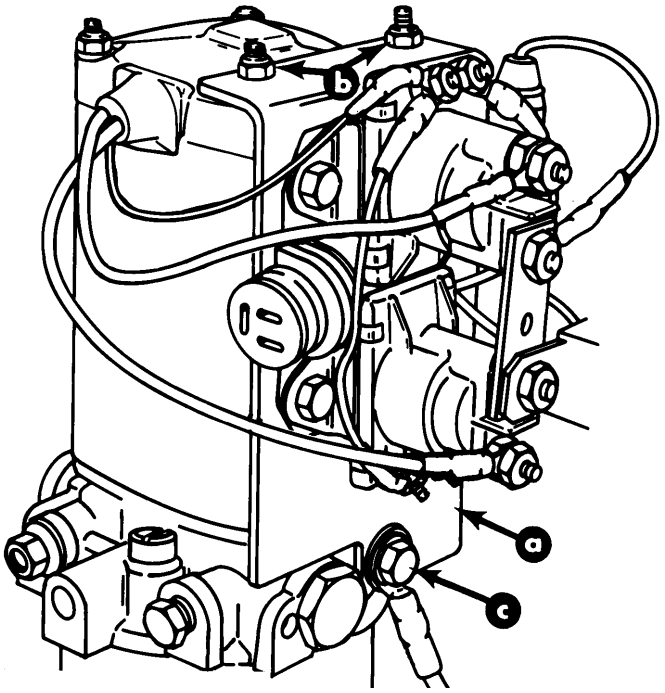


50471

a - Wires

12. Secure motor assembly to adaptor with 2 locknuts.

13. Slide solenoid plate onto studs and secure with 2 locknuts and screw.



50511

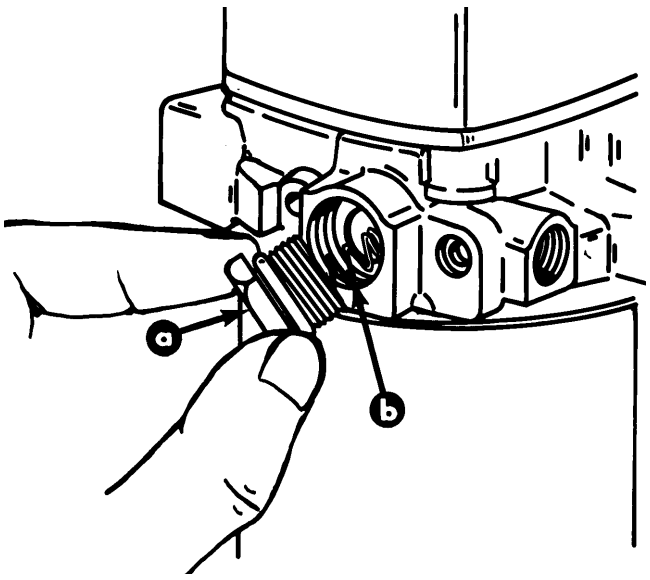
a - Solenoid Plate
b - Locknuts
c - Bolt

14. Uncap hydraulic lines and reconnect to adaptor.

Adaptor Repair

INTERNAL O-RING and POPPET VALVE REPLACEMENT

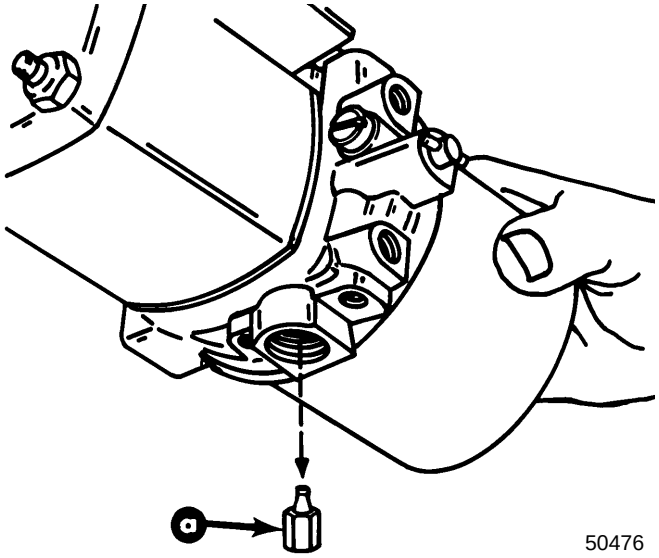
1. Remove hex plug retainers and springs (one on each side).



50474

a - Hex Plug Retainers (2)
b - Springs (2)

2. Tip pump to remove poppet valves and then discard the poppet valves.



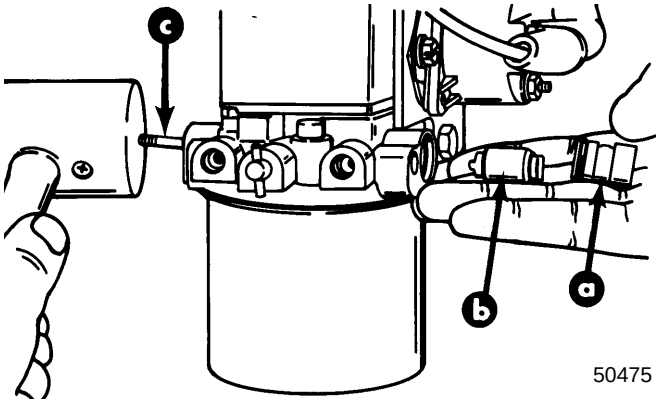
50476

a - Poppet Valves (2)

⚠CAUTION

Use care in removing check valve bodies from adaptor, so as not to damage poppet valve seat surface on valve body.

3. Remove check valve bodies and spool.

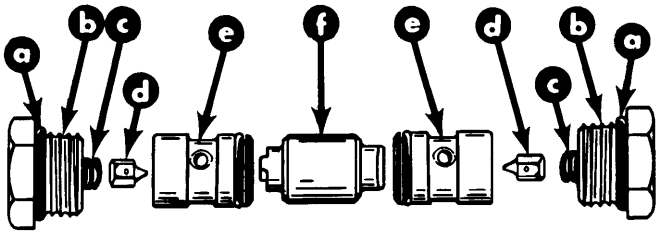


50475

a - Check Valve Body (2)
b - Spool
c - $^{1}/_{8}$ in. Diameter Rod (Provided With Trim Pump Rebuild Kit)

4. Remove and discard O-rings on hex plug retainers.
5. Discard check valve bodies.

6. Clean hex plug retainers and spool.



70867

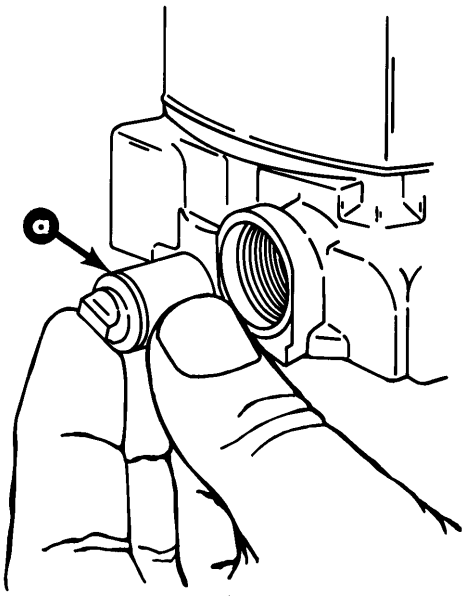
a - O-rings
b - Hex Plug Retainers
c - Springs
d - Poppet Valves
e - Check Valve Bodies
f - Spool

7. Lubricate check valve body O-rings with power trim and steering fluid, or with 10W-30 or 10W-40 motor oil.

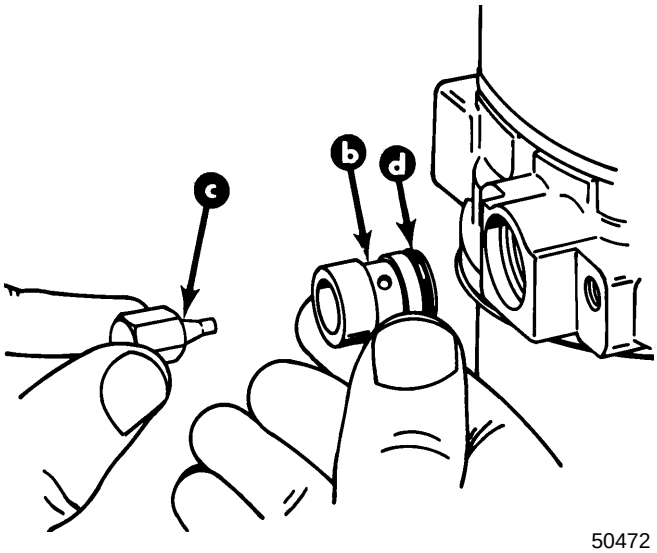
⚠CAUTION

DO NOT force check valve bodies into adaptor as damage to O-rings may result.

8. Place spool and check valve bodies into adaptor.
9. Place poppet valves into check valve bodies.



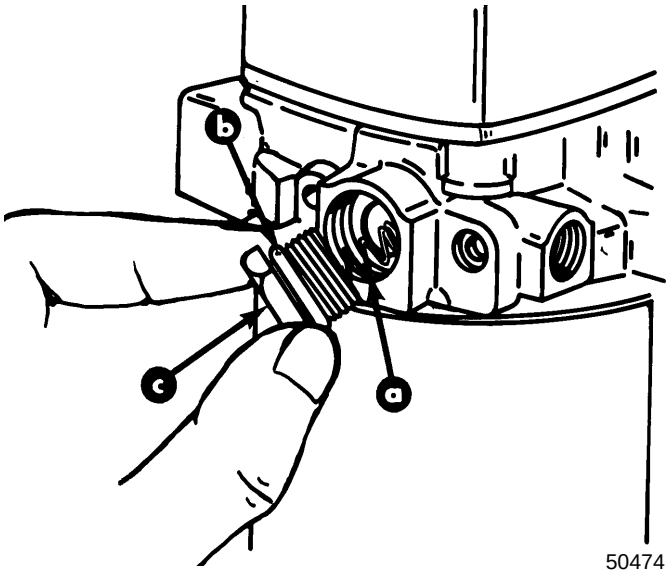
50509



50472

a - Spool
b - Check Valve Body (2)
c - Poppet Valve (2)
d - Check Valve Body O-ring (2)

10. Lubricate hex plug retainer O-rings with power trim and steering fluid or 10W-30 or 10W-40 motor oil.
11. Place spring into hex plug retainers.
12. Thread hex plug retainers into adaptor by hand until retainer contacts check valve body.



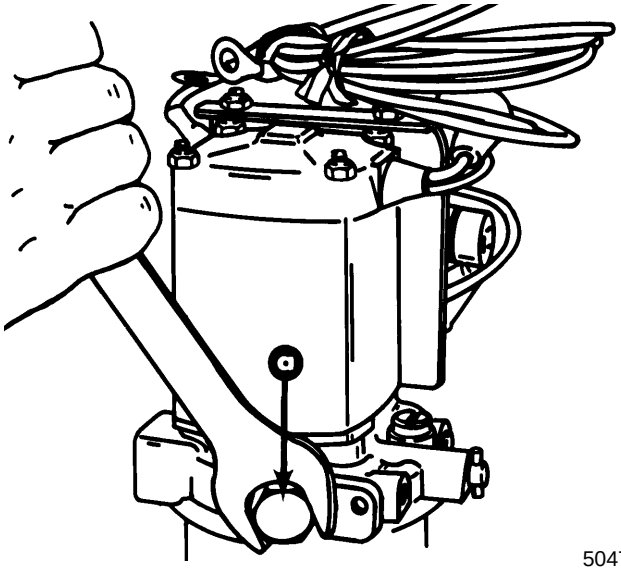
50474

a - Spring (2)
b - O-ring (2)
c - Hex Plug Retainer (2)

⚠CAUTION

Hex plug retainers MUST BE turned into adaptor exactly as outlined or damage to check valve body O-rings may result.

13. Tighten hex plug retainer 1/4 turn, then back off 1/8 turn. Repeat until hex plug is tightened securely.

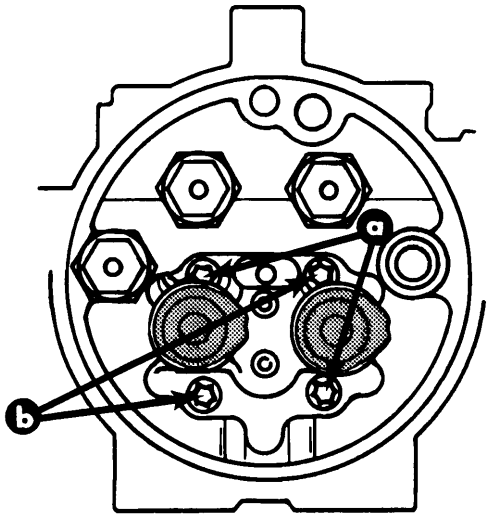


50476

a - Hex Plug Retainer (2)

Pump Shaft Oil Seal Replacement

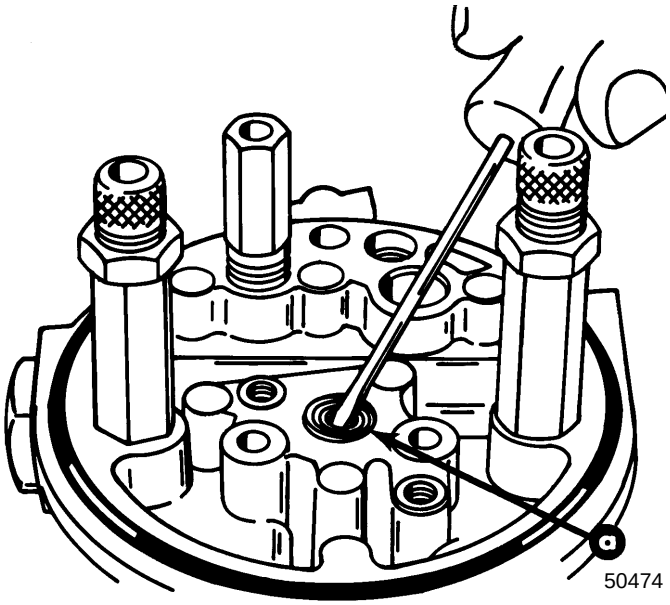
1. Remove reservoir.
2. Remove pump attaching screws with a hex lobular socket or standard 3/16 in. socket. Remove pump. DO NOT remove pump assembly screws.



70870

a - Screws
b - Pump Assembly Screws

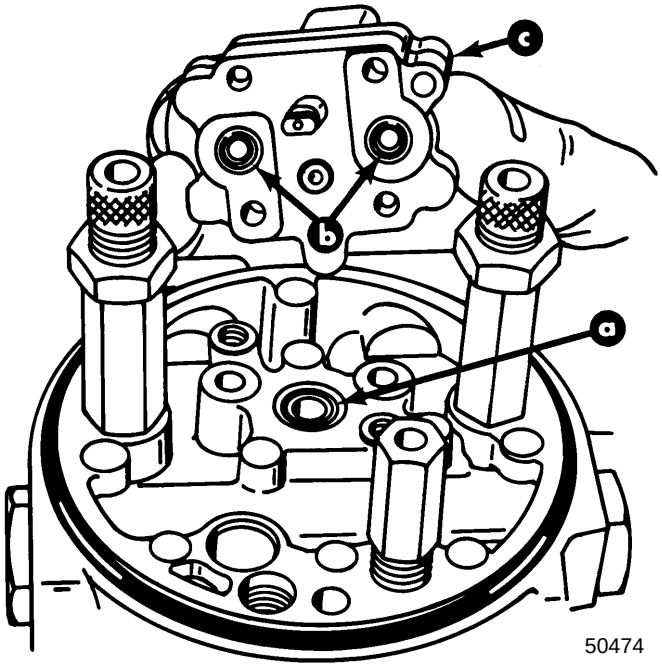
3. Remove oil seal by prying out with a screwdriver.



50474

a - Oil Seal

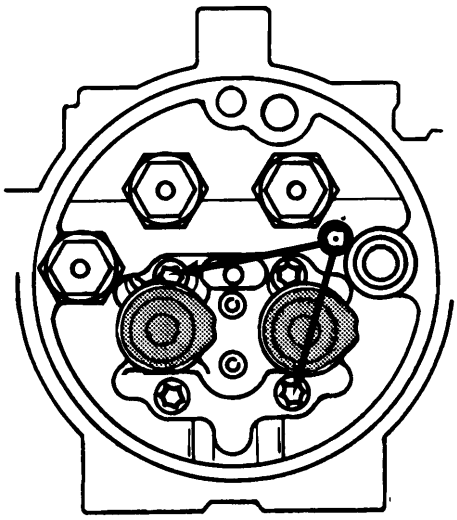
4. Remove and replace O-rings on pump base.
5. Install new seal with lips toward pump. Oil seal can be pressed in by hand.
6. Lubricate lip of seal with light weight oil.



50474

a - Oil Seal - Lip Toward Pump
b - O-rings
c - Pump

7. Install pump and torque screws to 75 lb. in. (8 N·m) using a hex lobular socket or a standard 3/16 in. socket.



70870

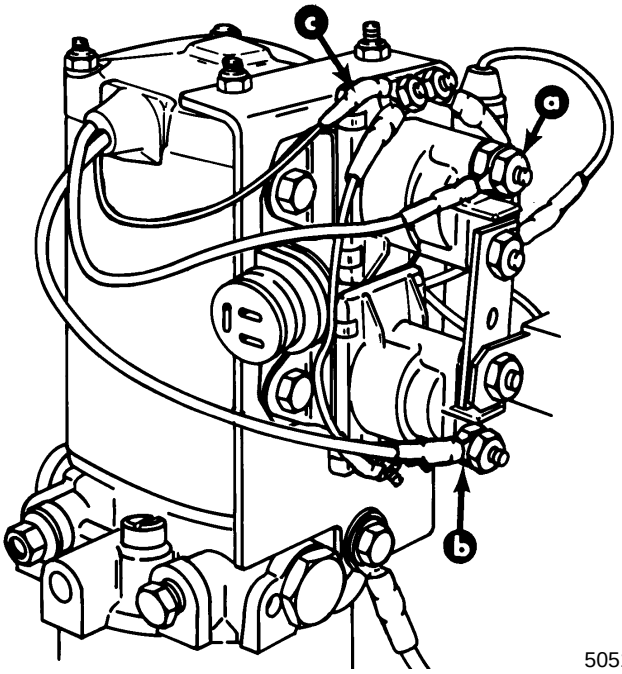
a - Screws

8. Install pump reservoir and O-rings.

Motor Repair

Disassembly

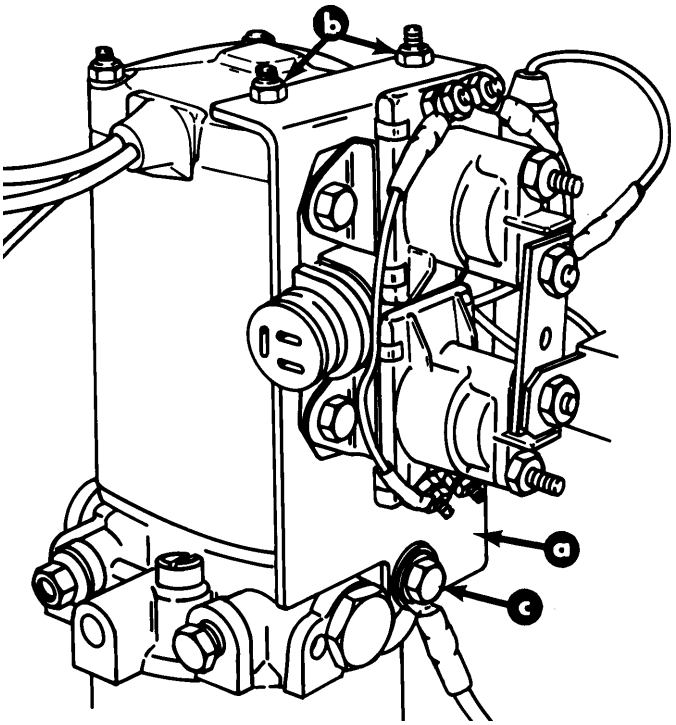
1. Disconnect motor leads (green-white, BLUE/WHITE and black) from solenoid terminals.



50511

a - BLUE/WHITE Motor Wire
b - GREEN/WHITE Motor Wire
c - BLACK Ground Wire

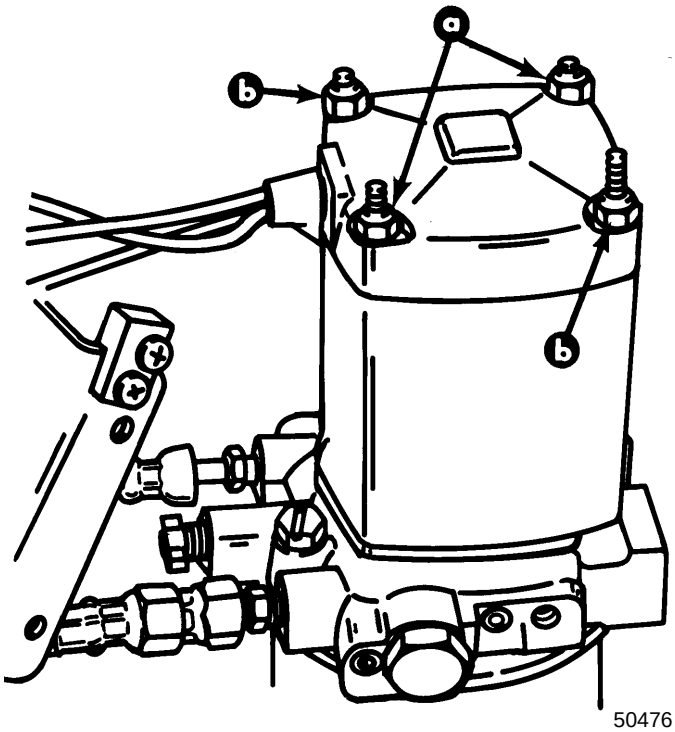
2. Remove solenoid plate.



50511

a - Solenoid Plate
b - Locknuts
c - Screw

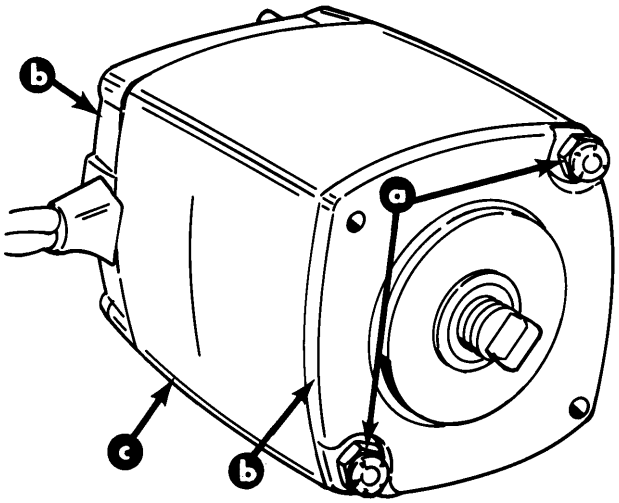
3. Remove motor assembly. Remove O-ring from motor base.



50476

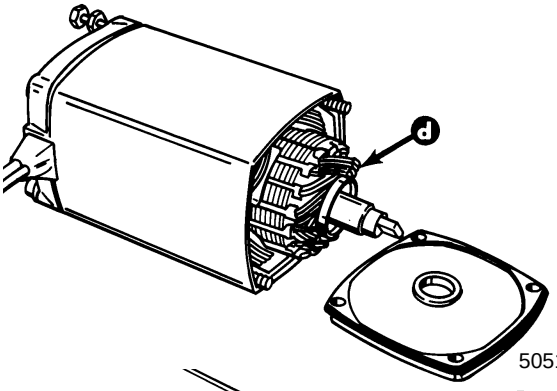
a - Locknuts (Studs May Turn Out)
b - DO NOT Loosen

4. Disassemble motor as follows:
   a. Remove end frame caps.
   b. Remove thrust washer (if equipped).
   c. Remove armature from field and frame assembly.

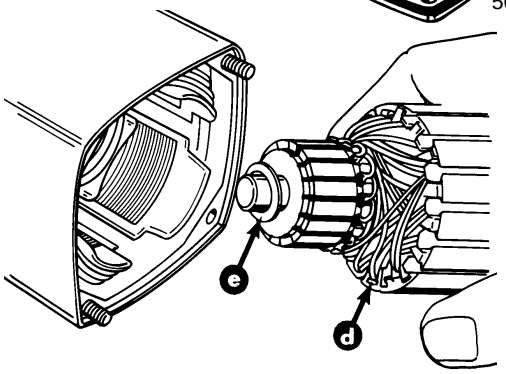


50475

a - Locknuts
b - End Frame Caps
c - Field And Frame Assembly



50511



50512

d - Armature
e - Thrust Washer

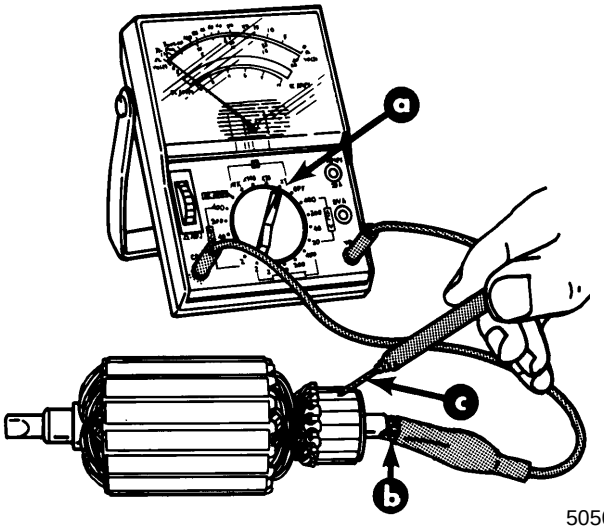
Armature Tests

CONTINUITY TEST

1. Check armature for continuity. Set ohmmeter on Rx1 scale. Place leads on armature shaft and on each commutator bar one at a time.

Continuity Indicated: Armature is grounded (replace armature).

Continuity Not Indicated: Armature is not grounded.



50509

a - Ohmmeter
b - Meter Lead
c - Meter Lead

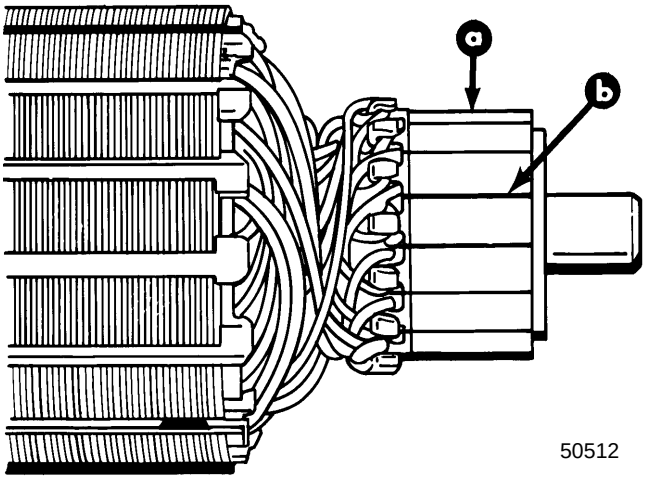
TEST FOR SHORTS

1. Check armature on a growler (follow growler manufacturers instructions). Indication of a short requires replacement.

CLEANING COMMUTATOR

NOTE: *If commutator is worn it can be turned down on a lathe or an armature conditioner tool.*

1. Clean commutator with “00” garnet grit sand paper. DO NOT use emery paper.
2. Check gaps between commutator bars for material. Remove material if present.



50512

a - Commutator
b - Gap

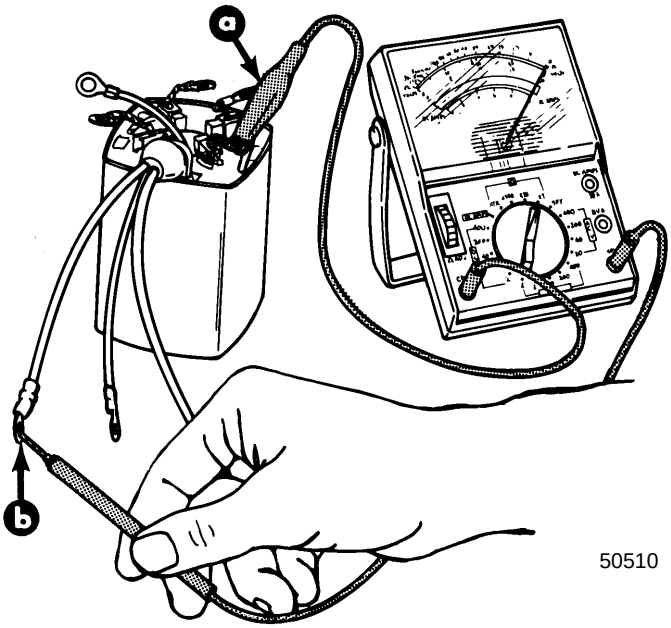
Field Test

TEST FOR OPEN CIRCUIT

1. Connect ohmmeter between field brush lead and BLUE/WHITE lead.

Zero Ohms Indicated (Full Continuity): Field OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.



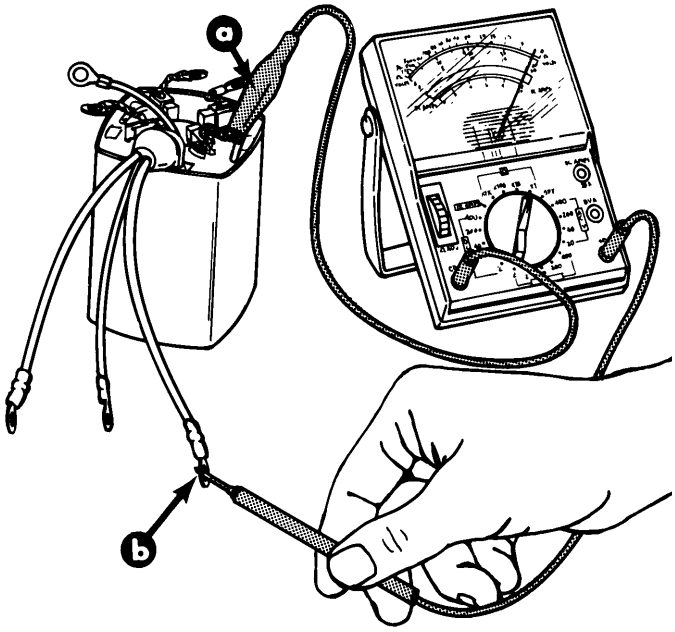
50510

a - Ohmmeter Lead- Connected to Field Brush Lead
b - Ohmmeter Lead - Connected To BLUE/WHITE Lead

2. Connect ohmmeter between field brush lead and GREEN/WHITE lead.

Zero Ohms Indicated (Full Continuity): Field OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.



50510

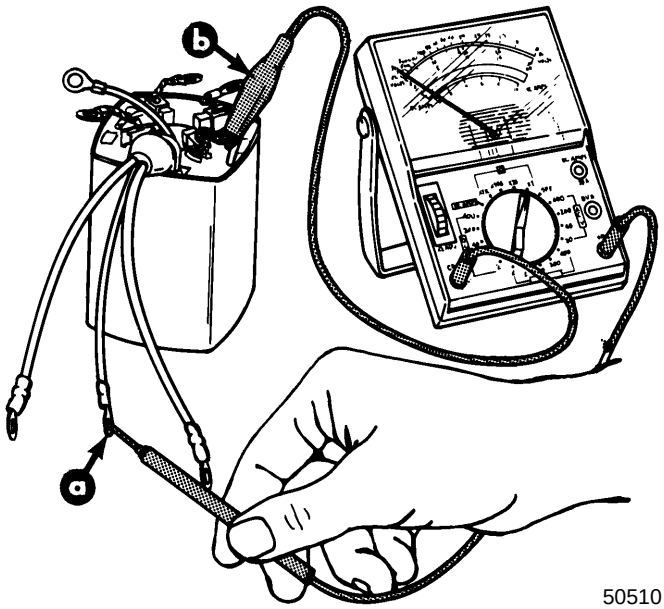
a - Ohmmeter Lead - Connected to Brush Lead
b - Ohmmeter Lead - Connected to GREEN/WHITE Lead

TEST FOR SHORT IN FIELD

1. Connect ohmmeter between field brush lead and field frame.

Zero Ohms Indicated (Full Continuity): Short indicated (Replace field assembly).

Zero Ohms Not Indicated (No Continuity): Field OK.



50510

a - Field Frame
b - Field Brush Lead

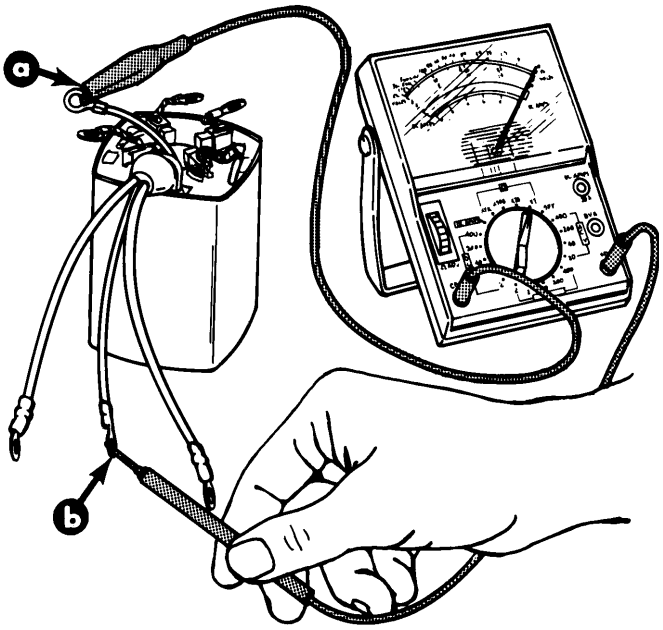
Thermal Switch Test

CONTINUITY TEST

1. Connect ohmmeter between black wires as shown.

Zero Ohms Indicated (Full Continuity): Switch OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.

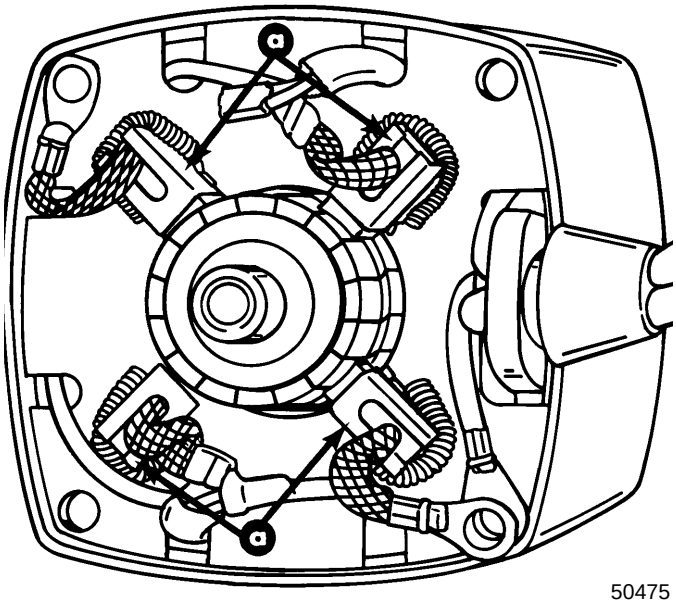


50510

a - Thermal Switch Wire
b - BLACK Field Wire

Brush Replacement

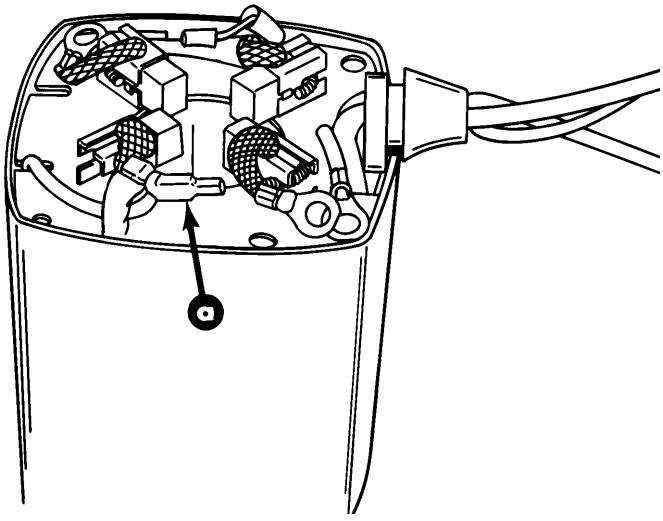
1. Replace brushes if:
   - Pitted
   - Chipped
   - Distance between brush pigtail and end of brush holder slot is 1/16 in. (1.6 mm) or less.



50475

a - Brushes

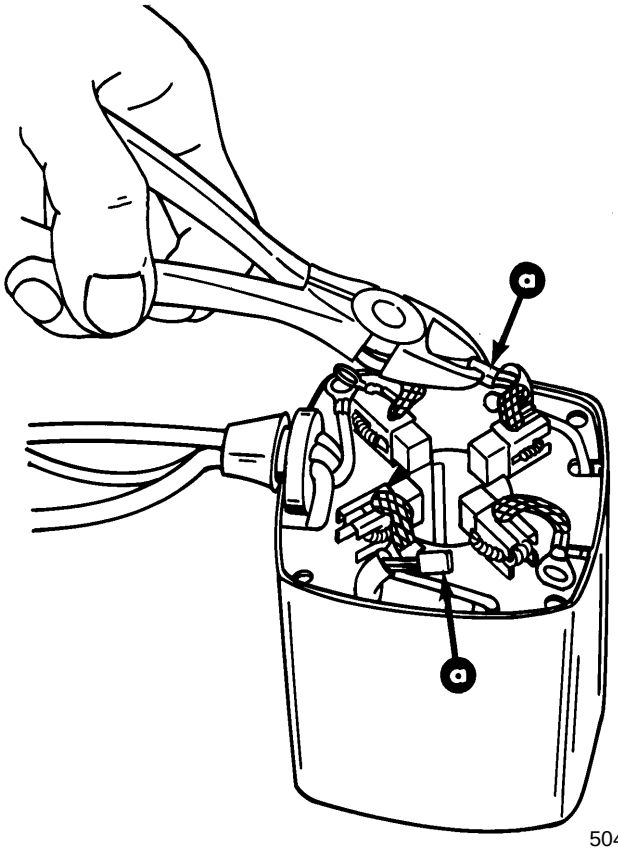
2. Remove plastic casing.



50471

a - Plastic Casing

3. Remove the metal connectors from the ends of the brush pigtails by separating the slit in the connectors using a side cutter. Retain connectors.



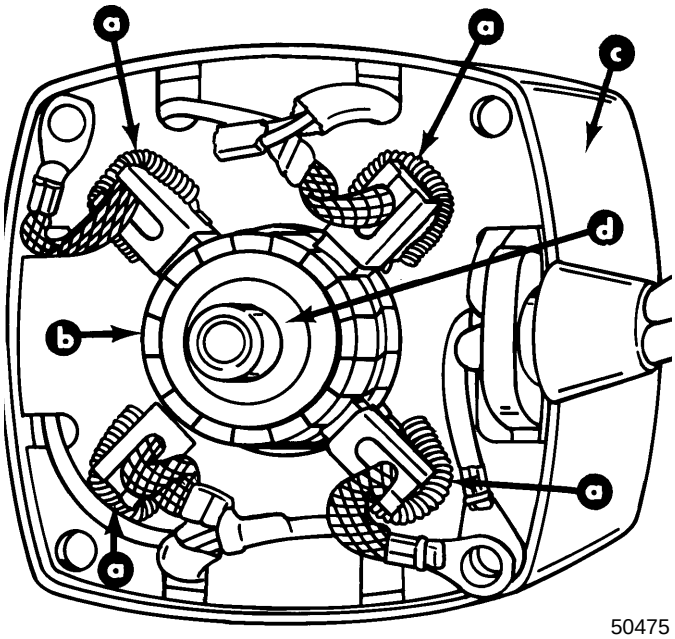
50475

a - Metal Connectors

4. Remove old brush card from field and frame assembly.
5. Insert new brush card into field and frame assembly.
6. Connect brush pigtails to field leads with metal connectors. Crimp metal connectors with a pliers.
7. Use shrink tubing to insulate the connections to prevent connections from grounding against end frame cap.

Reassembly

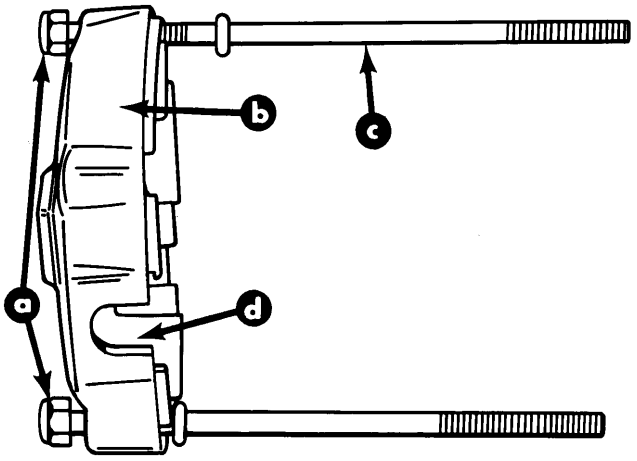
1. Spread brushes and install armature into field and frame assembly.
2. Install thrust washer, if equipped, onto armature shaft.



50475

a - Brushes
b - Armature
c - Field and Frame Assembly
d - Thrust Washer (If Equipped)

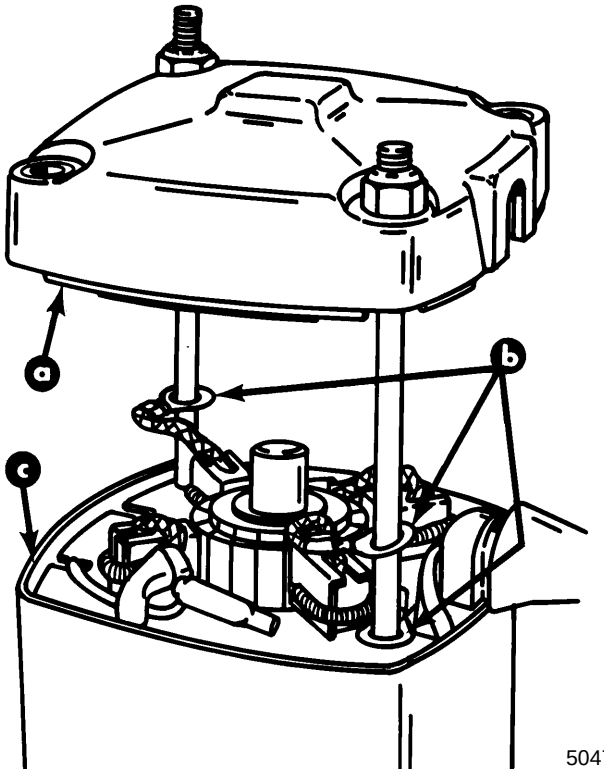
3. Install through studs.
4. Hold studs in soft jawed vise and tighten locknuts against cap.



50471

a - Locknuts
b - Upper End Cap
c - Longer Stud
d - End Cap Motor Lead Recess

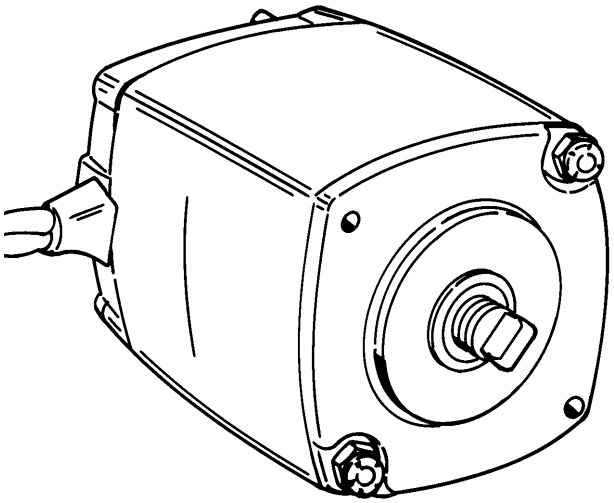
5. Install upper end frame cap - insert studs through brush lead ring terminals and stud holes.



50473

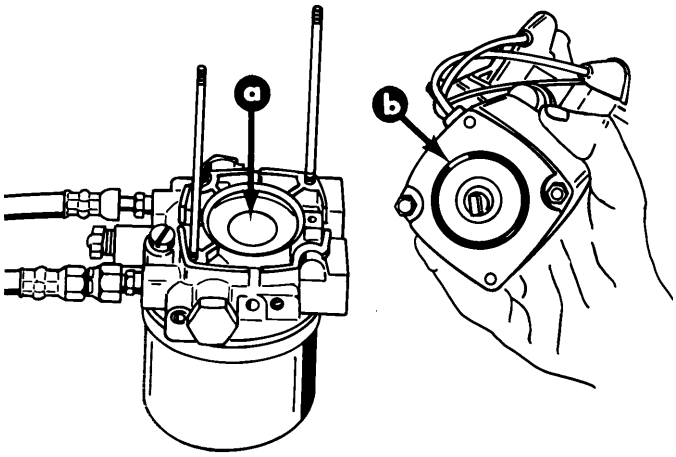
a - Upper End Cap
b - Brush Lead Ring Terminals
c - Field and Frame Assembly

6. Seal the seams between end frame caps and field and assembly with Liquid Neoprene (92-25711-1).
7. Install lower end frame cap onto through studs.
8. Install locknuts and tighten securely.



50475

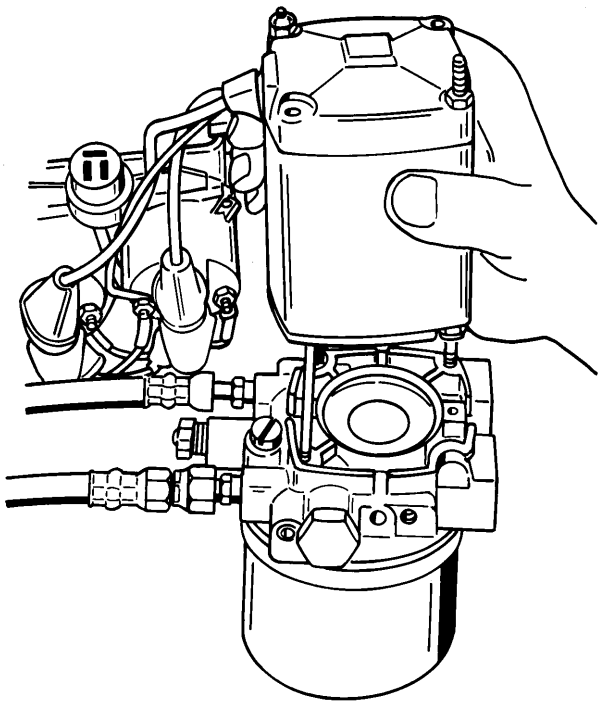
9. Install studs, coupling and new O-ring.
10. Install coupling with shallow slot toward oil reservoir.
11. Liberally lubricate coupling with 2-4-C Marine Lubricant.



50471

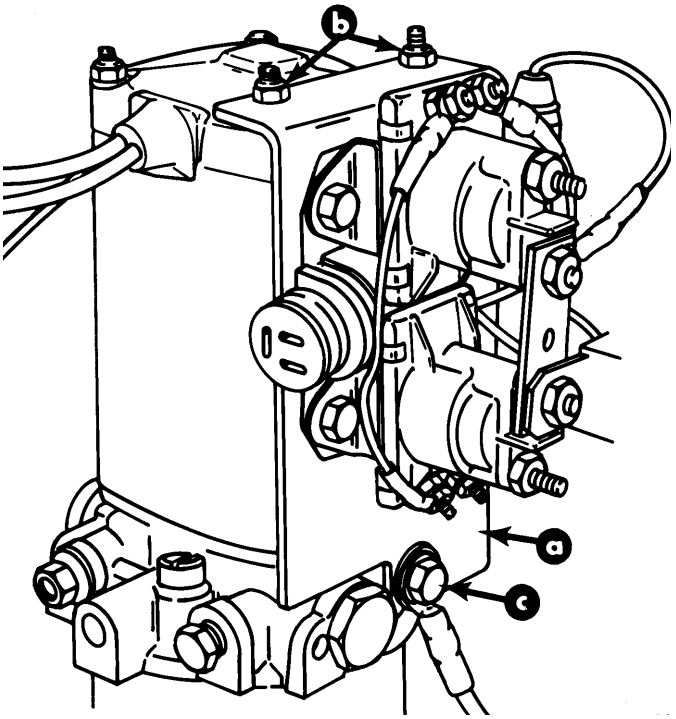
a - Coupling (Shallow Slot Toward Oil Reservoir)
b - O-ring

12. Install motor assembly.



50471

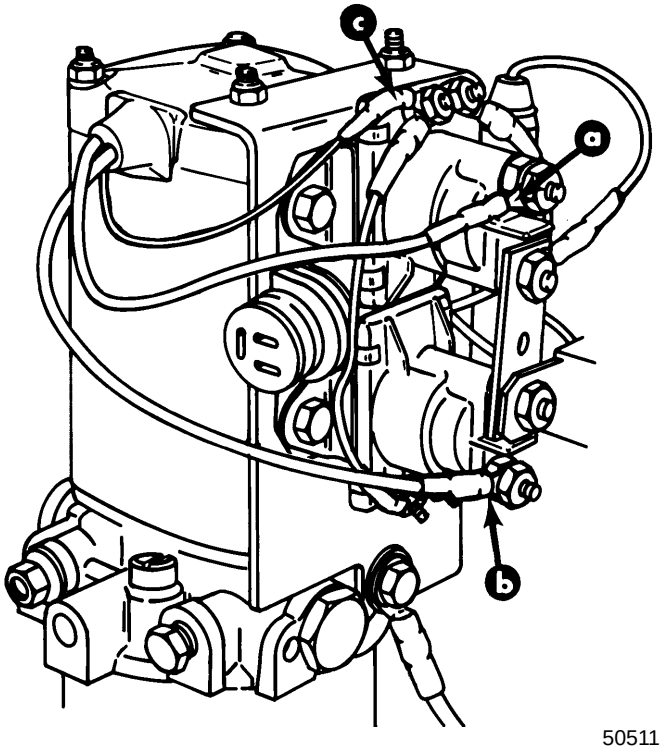
13. Install solenoid plate.



50511

a - Solenoid Plate
b - Locknuts
c - Bolt

14. Connect motor leads to solenoid terminals.



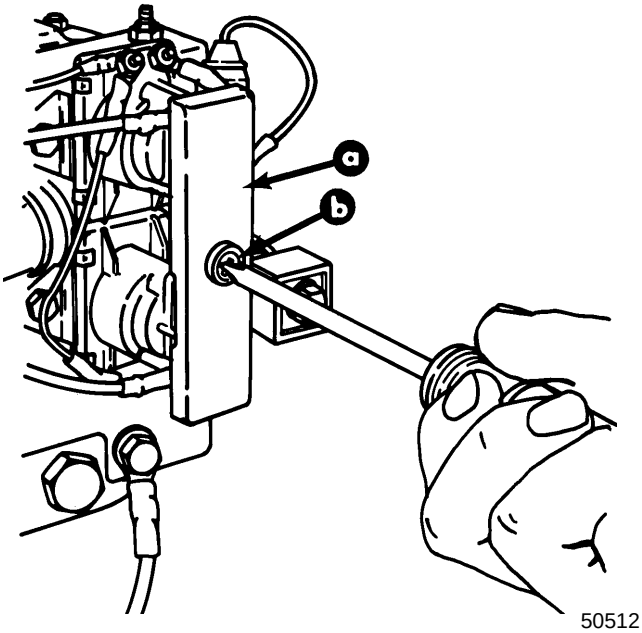
50511

a - BLUE/WHITE Motor Wire
b - GREEN/WHITE Motor Wire
c - BLACK Ground Wire

⚠CAUTION

Solenoid terminal cover screw is attached to 12 volt positive source. DO NOT GROUND screwdriver when installing cover.

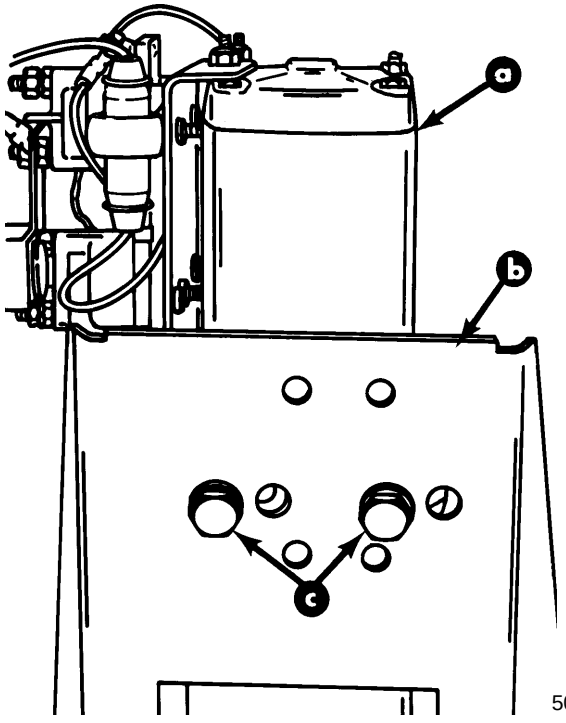
15. Install solenoid terminal cover. Tighten screw securely.



50512

a - Solenoid Terminal Cover
b - Screw

16. Install trim pump on floor bracket. Tighten securely.

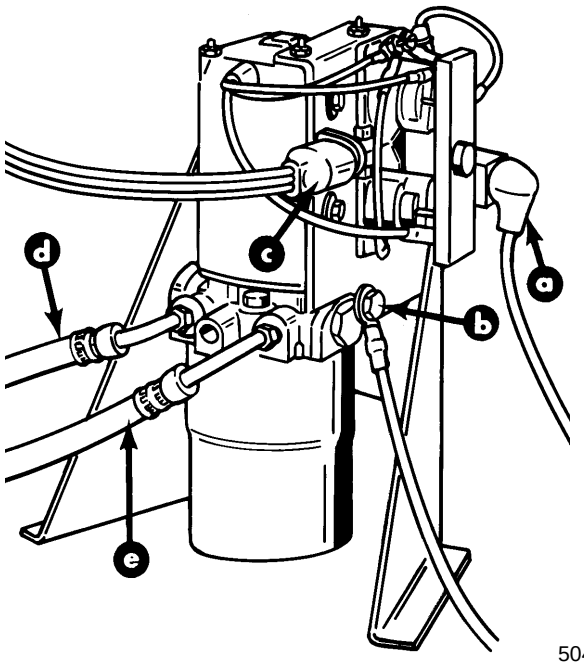


50509

a - Trim Pump
b - Floor Bracket
c - Screws And Lock Washers

Trim Pump Installation

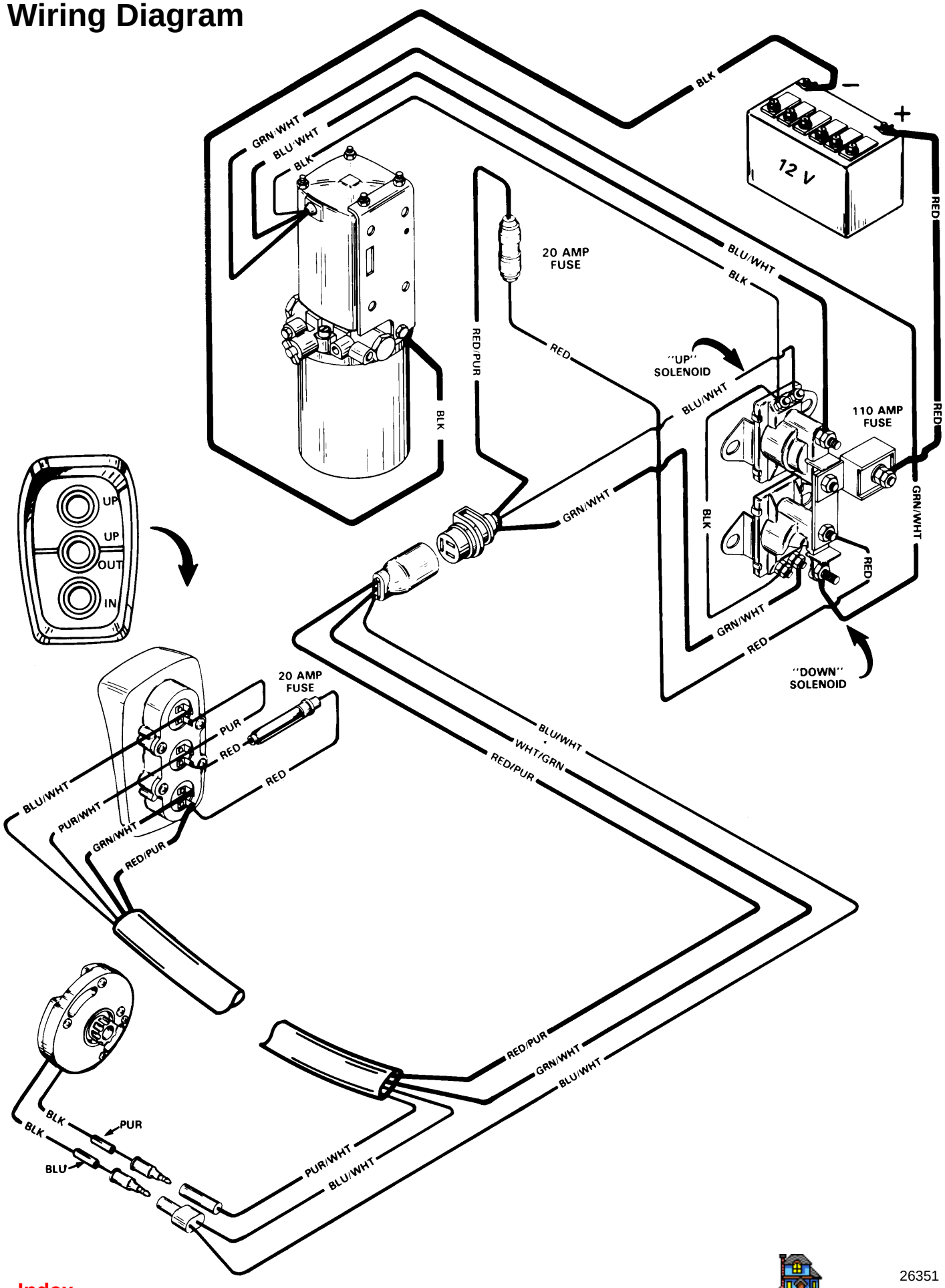
1. Secure pump and mounting bracket to boat using lag bolts and washers.
2. Reconnect trim hoses to pump. Black hose to left connection; gray hose to right connection. DO NOT cross-thread or overtighten hose fittings. Torque to 70 - 150 lb. in. (8 - 17 N·m).
3. Reconnect trim harness connector to trim pump.
4. Reconnect battery leads to battery.
5. Check fluid level and fill if necessary. (Refer to “Maintaining Power Trim Pump Oil Level” in this section).



50494

a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)

Wiring Diagram



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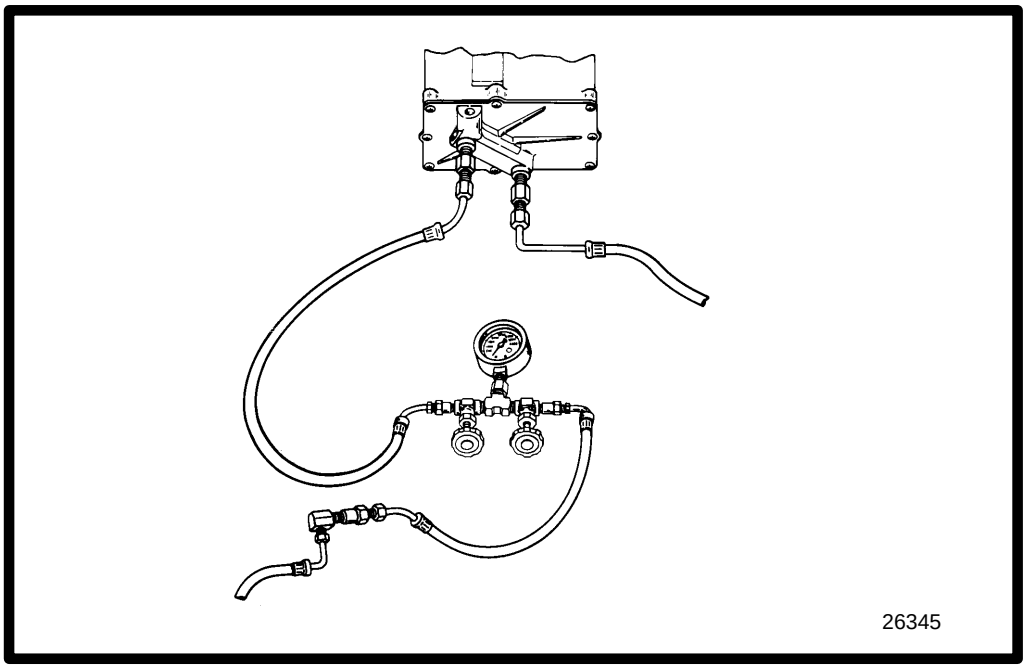
POWER TRIM



5
C

PRESTOLITE POWER TRIM PUMP

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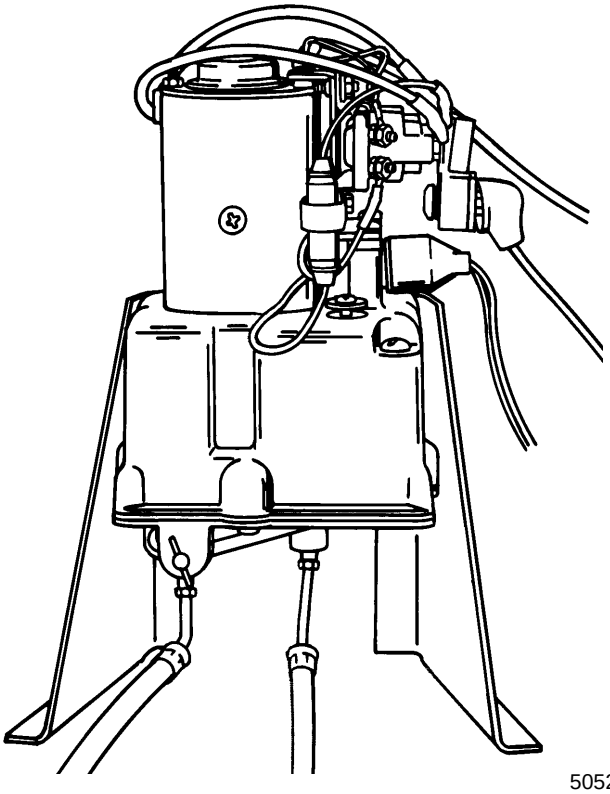
Identification

Some MerCruiser Sterndrives will be equipped with a Prestolite Power Trim pump. This pump was used interchangeably with the Oildyne pump for a period of time.



50524

Prestolite Power Trim Pump

Specifications

Valve Pressure Specifications

Valve	Pressure
Up Circuit	2200 - 2600 PSI (15173 - 17932 kPa)
Down Circuit	400 - 600 PSI (2759 - 4138 kPa)

Electrical Specifications

Pump Amperage Draw	115 Amps at 2200 - 2600 PSI (15173 - 17932 kPa)

Lubricants/Sealers/ Adhesives

Description	Part No.
Power Trim and Steering Fluid	92-90100A12
2-4-C Marine Lubricant	92-825407A2
Liquid Neoprene	92-25711-2

Special Tools

Description	Part No.
Test Gauge Kit	91-52915A6
Multi-Meter	91-99750
Torque Wrench (lb. ft.)	91-36210
Torque Wrench (lb. in.)	91-66274
Jumper Wire	Obtain Locally

Description

The Prestolite Power Trim Pump has internal valving that eliminates the need for an external reverse lock, as was required in the past. The pump generates a higher volume of fluid, but at a lower pressure than previous Prestolite pumps. This, in conjunction with large I.D. hydraulic hoses (gimbal housing to pump) and larger I.D. trim cylinders, should allow the drive unit to "kick-up" easier if an underwater object is struck.

⚠CAUTION

Due to differences in internal valving, the new Prestolite trim pump cannot be used to replace an earlier Prestolite pump, or vice-versa. Use of incorrect pump will affect trim operation and may cause damage to trim system.

The pump motor is protected from overheating by an internal circuit breaker (on commutator end plate), that interrupts the current flow through the field windings in the event of an overheating condition. Electrical current overload protection is provided to the pump by a 110 amp fuse. Pump also is fitted with a 20 amp in-line fuse, which serves to protect the trim control and harness from an overload.

Thermal Circuit Breaker Operation

If the IN/DOWN or "Trailer" switch is kept depressed after drive unit reaches its end of travel, a thermal circuit breaker will open to prevent pump motor from overheating and pump motor will stop. Release switch(es) as soon as drive unit reaches end of travel, to prevent this from happening. If circuit breaker should open, allow motor to cool down and circuit breaker will automatically reset.

Manual Release Valve Operation

⚠WARNING

Before loosening manual release valve, make sure all persons are clear of sterndrive unit.

In case of a Power Trim system malfunction, the sterndrive unit can be raised and lowered manually by turning the manual release valve counterclockwise approximately 3 turns and moving drive unit to desired position by hand. After drive unit has been placed in the desired position, close valve COMPLETELY. Power Trim system will not function properly, unless valve is completely closed.

Maintaining Power Trim Pump Oil Level

⚠CAUTION

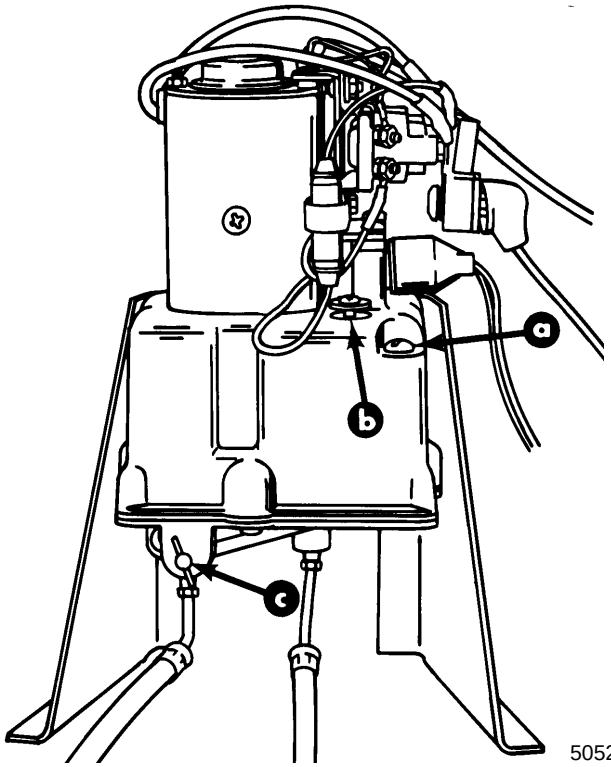
Vent screw MUST BE backed out two (2) full turns (after bottoming out) to vent pump reservoir. FAILURE TO BACK SCREW OUT COULD RESULT IN DAMAGE TO PUMP.

IMPORTANT: Check oil level with sterndrive unit in the full down position.

IMPORTANT: SAE 10W-30 or 10W-40 engine oil can be used in system, if Quicksilver Power Trim and Steering Fluid is not available.

1. Place drive unit in the full IN/DOWN position.
2. Remove "Fill" screw from pump. Oil level should be up to bottom of the threads in "Fill" screw hole. If necessary, add Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil (through "Fill" screw hole).

NOTE: *In tropical areas, single viscosity SAE 30 motor oil can be used.*



50524

a - Fill Screw
b - Vent Screw
c - Manual Release Valve

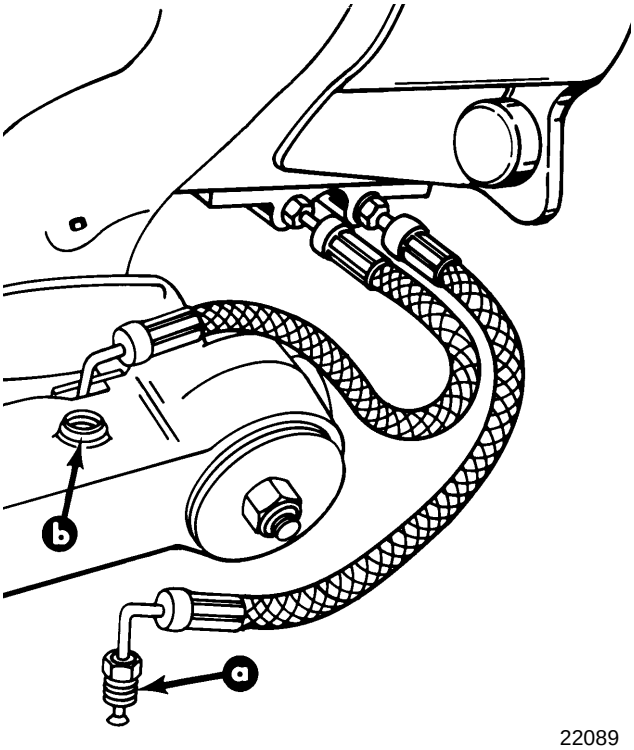
3. Raise and lower drive unit 6 to 10 times to purge any air from system; then, recheck oil level (with drive unit fully IN/DOWN) and add oil if necessary.

Air Bleeding Power Trim System

The power Trim System will purge itself of a small amount of air by raising and lowering the drive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the following bleeding procedure should be used to remove the air from the system.

Bleeding OUT/UP Trim Circuit

1. Fill pump reservoir to proper level as explained preceding. (Trim cylinder must be compressed).
2. Disconnect OUT/UP hose from front connection on trim cylinder. If both cylinders were rebuilt, disconnect hoses from both cylinders.
3. Direct end of trim hose(s) into a container.
4. Run trim pump in the UP direction until a solid, air-free stream of fluid is expelled from hose(s). Reconnect hose(s) and tighten securely.
5. Refill trim pump to proper level.

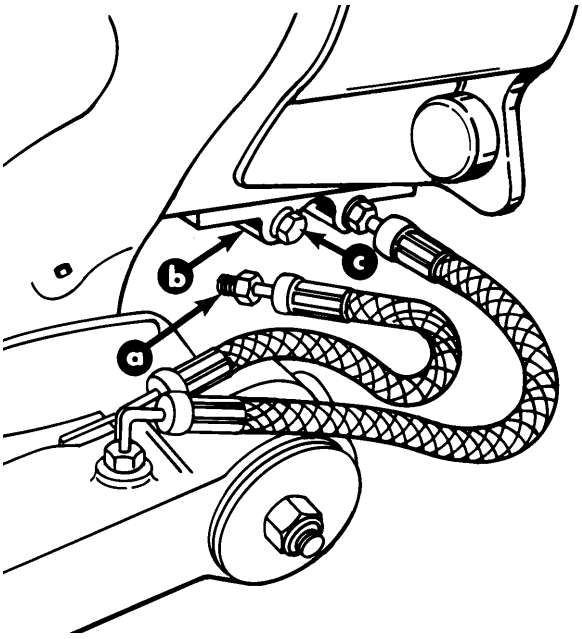


22089

a - OUT/UP Trim Hose
b - Front Connection on Trim Cylinder

Bleeding IN/DOWN Trim Circuit

1. Ensure pump reservoir is filled to proper level.
2. Disconnect IN/DOWN hose from rear connection on gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect hoses from both sides of hydraulic connector.
3. Plug holes in hydraulic connector, using plug (22-38609) or suitable device.
4. Direct end of trim hose(s) into container.
5. Run trim pump in the UP direction until trim cylinders are fully extended.
6. Remove plug(s) from gimbal housing hydraulic connector and momentarily run trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from rear hole(s) in hydraulic connector. Reconnect trim hose(s) and tighten securely.
7. Lower drive unit to the full IN/DOWN position and refill trim pump to proper level. Run trim system IN/DOWN and OUT/UP several times and recheck fluid level.



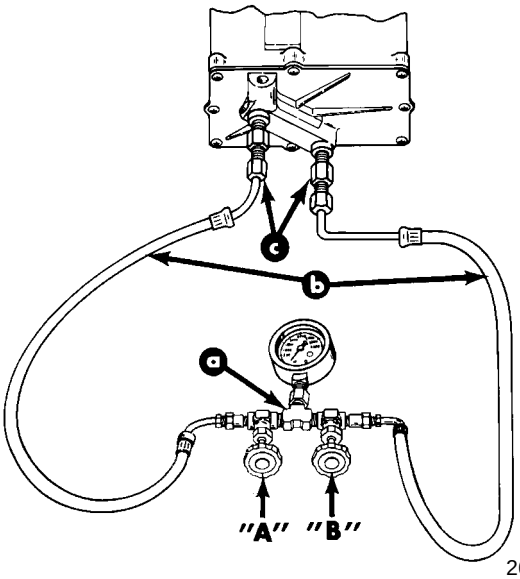
22089

a - IN/DOWN Trim Hose
b - Hydraulic Connector
c - Plug (22-38609)

Testing Power Trim Pump

Connecting Test Gauge

1. Check trim pump oil level. Fill if necessary.
2. Place drive unit in the full IN/DOWN position.
3. Connect test gauge at the most convenient location (at pump or hydraulic connector).

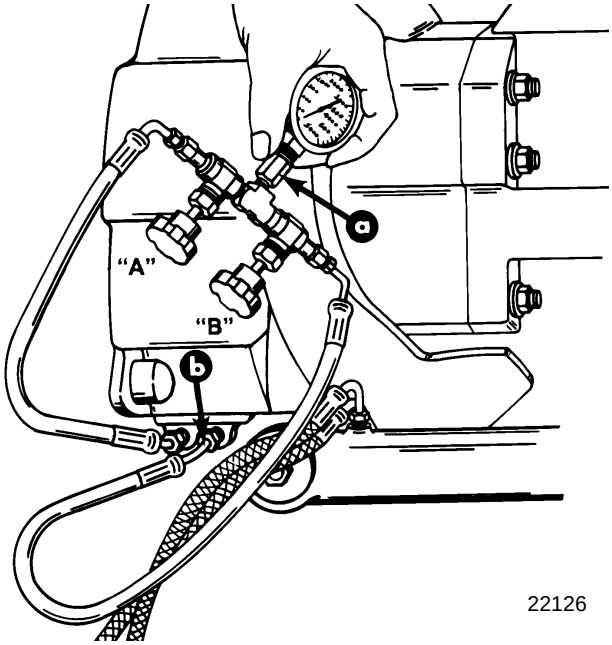


26344

Gauge Connected at Pump

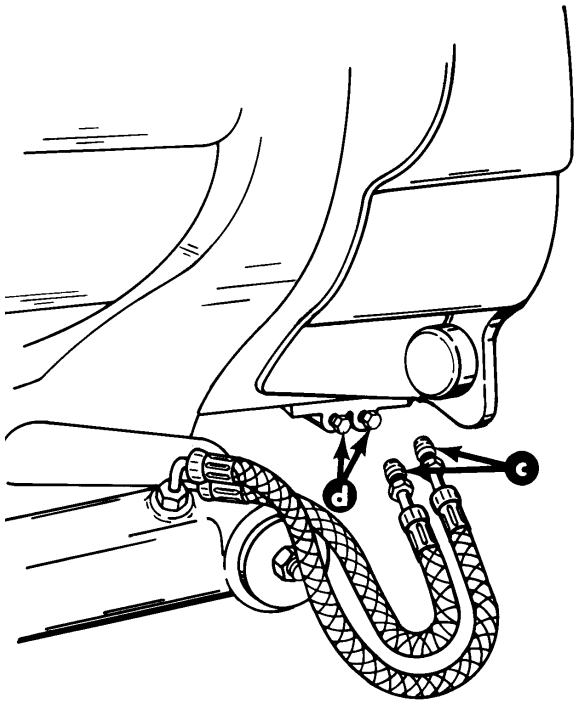
a - Hydraulic Test Gauge 91-52915A6
b - Extension Hoses 91-52915A6
c - Fittings 22-77366

NOTE: *Extension hoses MUST BE used to obtain accurate readings.*



22126

a - Hydraulic Test Gauge (91-52915A6)
b - Gimbal Housing Hydraulic Connector



22090

Gauge Connect to Hydraulic Connector

c - Caps
d - Plugs

4. Open Valve “A” and “B” and run pump UP and DOWN several times (to purge air).

Internal Restriction Test

1. Open valve “A” and “B.”
2. Run pump OUT/UP and IN/DOWN while observing gauge.
3. Replace adapter, if pressure is in excess of 200 psi (1379 kPa).

OUT/UP Pressure Test

1. Leave Valve “A” open and close Valve “B.”
2. Run pump OUT/UP while observing gauge. Reading should be 2200 - 2600 psi (15173 - 17932 kPa). If not, replace valve body and gear assembly.
3. Stop pumping OUT/UP. Pressure should not fall below 1900 psi (13104 kPa). If it does, check for and/or replace following:

- External oil leaks
- Valve Body and Gear Assembly

IN/DOWN Pressure Test

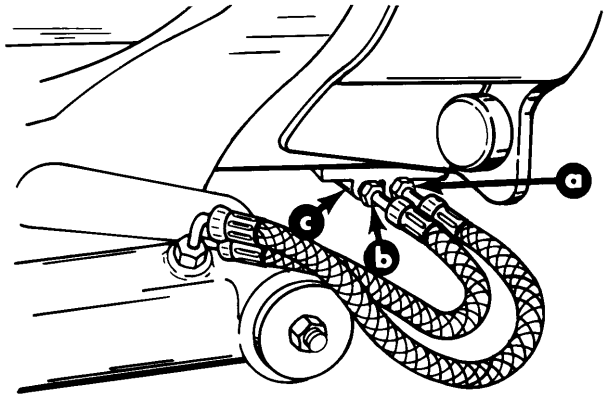
1. Close Valve “A” and open Valve “B.”
2. Run pump IN/DOWN while observing gauge. Reading should be 400 - 600 psi (2759 - 4138 kPa). If not, replace valve body and gear assembly.
3. Stop pumping IN/DOWN. Pressure should not fall below 350 psi (2410 kPa). If it does, check for and/or replace the following:

- External oil leaks
- Valve Body and Gear Assembly

Trim Cylinder Internal Leak Test

IMPORTANT: The following test assumes that pump OUT/UP pressure is within specifications as determined by performing “Power Trim Pump Test.”

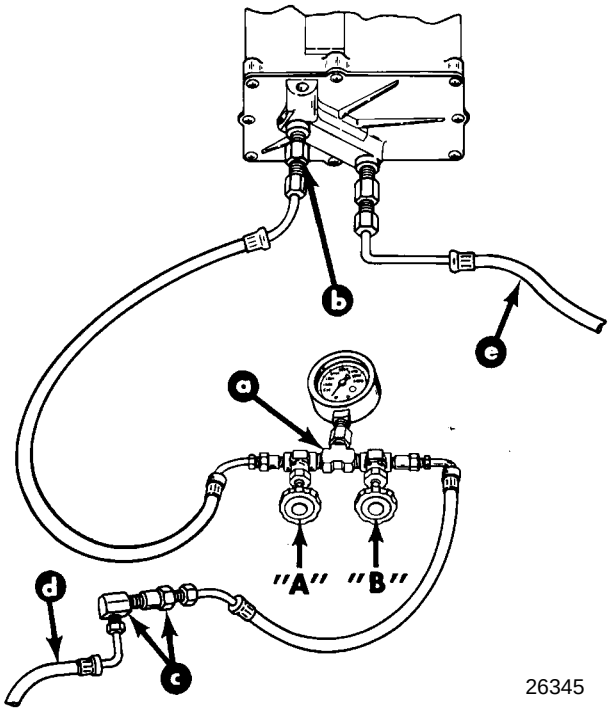
1. Reconnect trim cylinder hoses (if removed in previous test) as follows:
   a. Remove plugs and caps.
   b. Install UP hose to forward hole on hydraulic connector. Tighten securely.
   c. Install DOWN hose to aft hole on hydraulic connector. Tighten securely.



22090

a - UP Hose
b - DOWN Hose
c - Hydraulic Connector

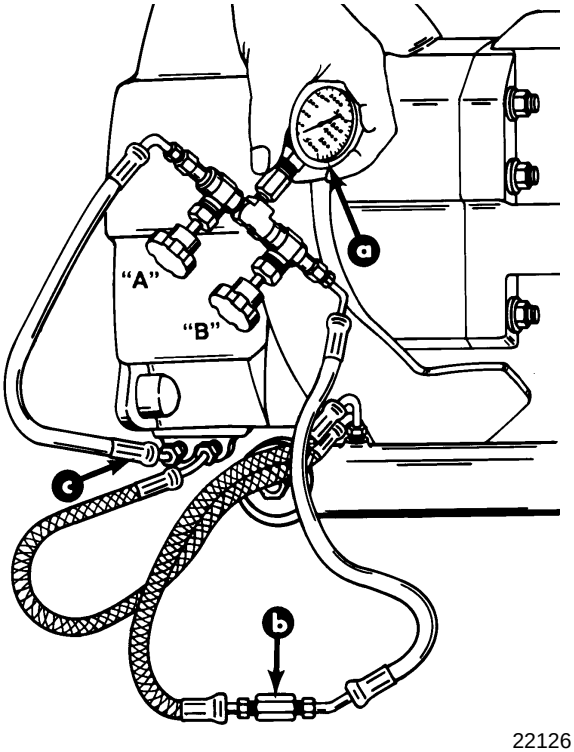
2. Connect gauge at most convenient location.



26345

Gauge Connected at Pump

a - Hydraulic Test Gauge 91-52915A3
b - Fitting (22-77366)
c - Fittings (Supplied with Gauge)
d - Black Hydraulic Hose (From Gimbal Housing)
e - Gray Hydraulic Hose (From Gimbal Housing)



22126

Gauge Connected to Hydraulic Connector

a - Test Gauge
b - Coupling (Supplied with Gauge)
c - Front Hydraulic Connector Port

3. Open Valve “A”and “B” and run pump OUT/UP and IN/DOWN; several times (to purge air).
4. Run pump OUT/UP until trim cylinders are fully extended; then, observe gauge while pumping. Pressure should be 2200 - 2600 psi (15173 - 17932 kPa).
5. Stop pumping OUT/UP. Pressure should not fall below 1900 psi (13104 kPa).
   If readings are not within specifications, an internal trim cylinder leak is indicated. Use the following procedure to locate faulty cylinder.
   a. If gauge is connected at pump, reconnect gauge at gimbal housing hydraulic connector. Repeat Step 2; then, run pump in OUT/UP direction until trim cylinder are fully extended.
   b. Close Valve “B” on test gauge and repeat Steps 3 and 4.

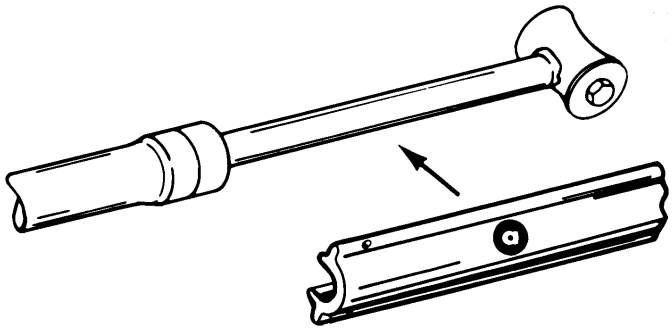
If Readings Are Now Within Specifications: Trim cylinder on the same side that test gauge is connected, is faulty.

If Readings Are Still Not Within Specifications: Trim cylinder on the opposite side from where the test gauge is connected, is faulty.

Trim Cylinder Shock Piston Test

If trim system checks out good, but drive unit will not trim IN/DOWN, problem may be due to a leaky trim cylinder shock piston. Use the following test to check for this condition. Test gauge is not required.

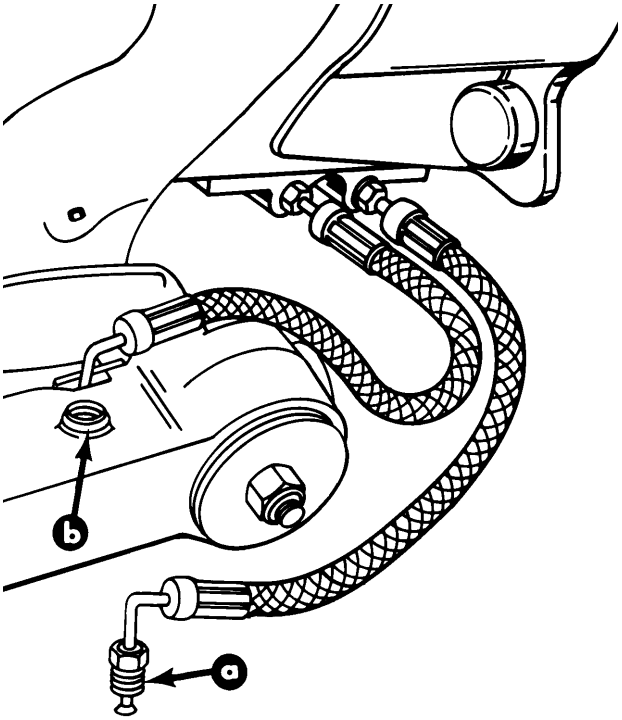
1. Run pump in OUT/UP direction until trim cylinders are fully extended.
2. Prevent trim cylinder piston rods from retracting, using a suitable device. Quicksilver Trailering Kit works well for this purpose.



22562

a - Trailering Clip

3. Disconnect UP trim hose from trim cylinders.



22089

a - UP Trim Hose
b - Front Connection

4. Run pump in IN/DOWN direction. If oil flows from UP port on trim cylinder, shock piston is leaking and must be replaced.

Motor and Electrical Bench Tests

Trim Pump Motor Test (In Boat)

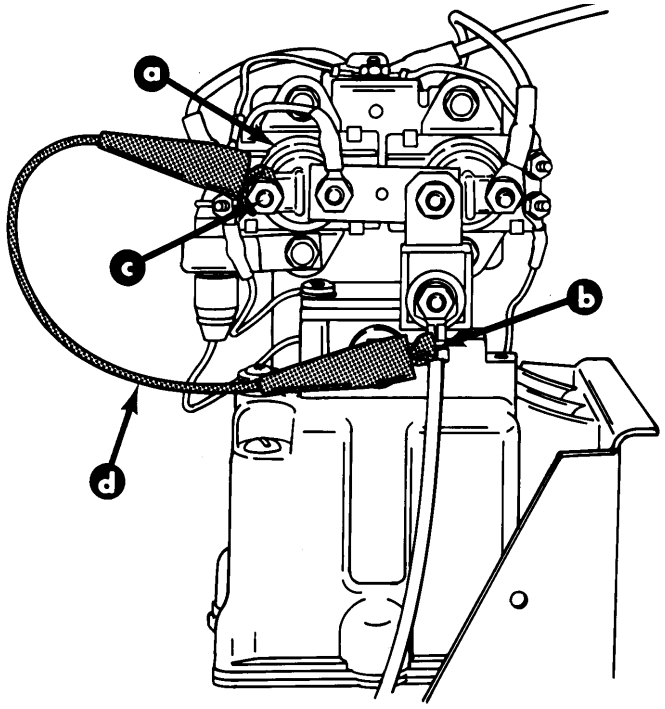
⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

⚠WARNING

Remaln clear of drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

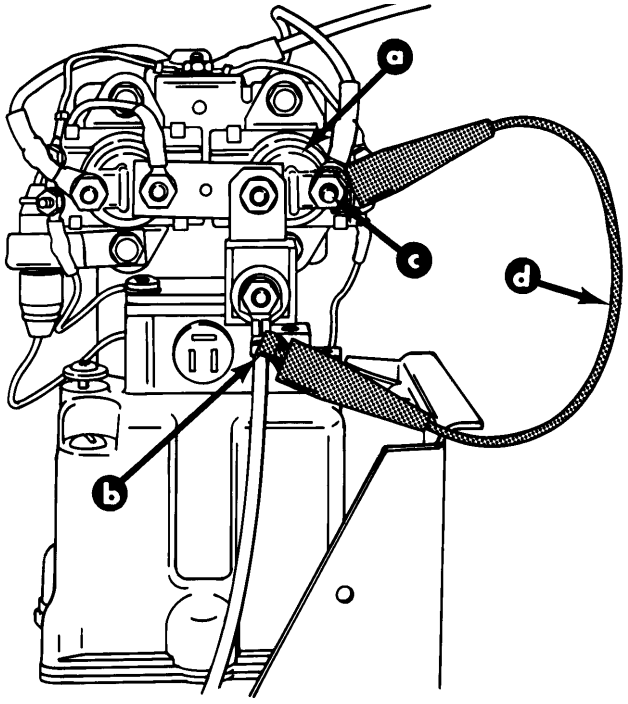
1. OUT/UP Operation:
   a. Connect a jumper wire between positive (+) solenoid terminal and BLUE/WHITE motor lead terminal.
   b. Motor should run.



50523

a - OUT/UP Solenoid
b - POSITIVE Terminal (+)
c - BLUE/WHITE Motor Lead Terminal
d - Jumper Wire

2. IN/DOWN Operation:
   a. Connect a jumper wire between positive (+) solenoid terminal and GREEN/WHITE motor lead terminal.
   b. Motor should run.



50523

a - IN/DOWN Solenoid
b - POSITIVE Terminal (+)
c - GREEN/WHITE Motor Lead Terminal
d - Jumper Wire

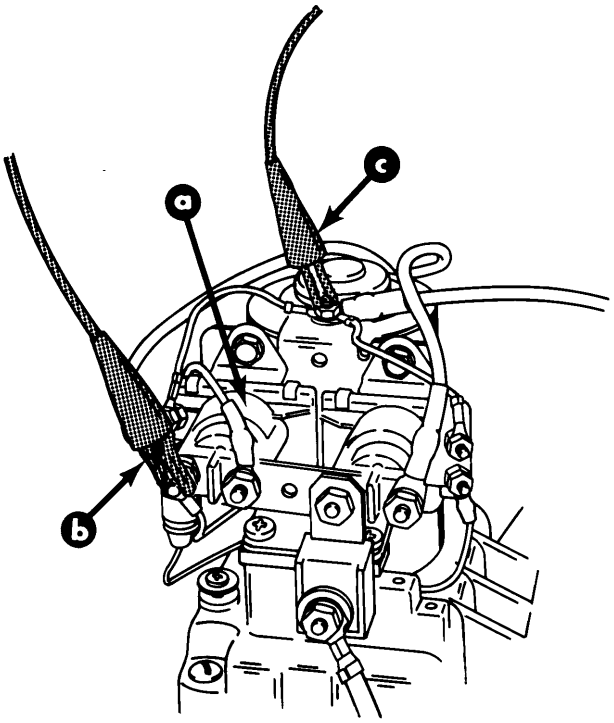
3. If motor does not run, refer to “Motor Repair.” See Table of Contents.

Trim Pump Motor Test (Out of Boat)

⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

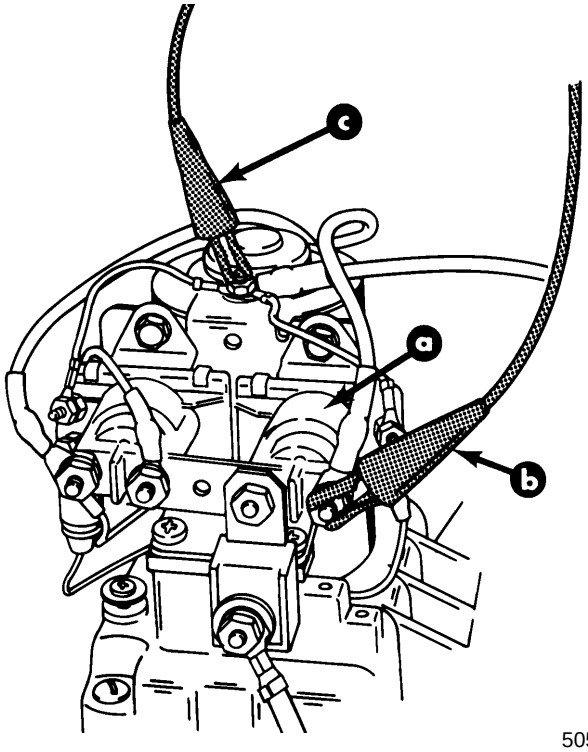
1. Remove trim pump from boat. Refer to “Trim Pump Removal.” See Table of Contents.
2. Remove fluid from trim pump reservoir.
3. OUT/UP Operation:
   a. Connect a 12 volt positive (+) supply lead to BLUE/WHITE motor lead terminal.
   b. Connect the negative (-) supply lead to a good ground on pump.
   c. Motor should run.



50523

a - OUT/UP Solenoid
b - 12 Volt POSITIVE (+) Supply Lead
c - NEGATIVE (-) Supply Lead

4. IN/DOWN Operation:
   a. Connect a 12 volt positive (+) supply lead to GREEN/WHITE motor lead terminal.
   b. Connect the negative (-) supply lead to a good ground on pump.
   c. Motor should run.



50524

a - IN/DOWN Solenoid
b - 12 Volt POSITIVE (+) Supply Lead
c - NEGATIVE (-) Supply Lead

NOTE: *If motor does not run, refer to "Motor Repair."*

Solenoid Test (Pump in Boat)

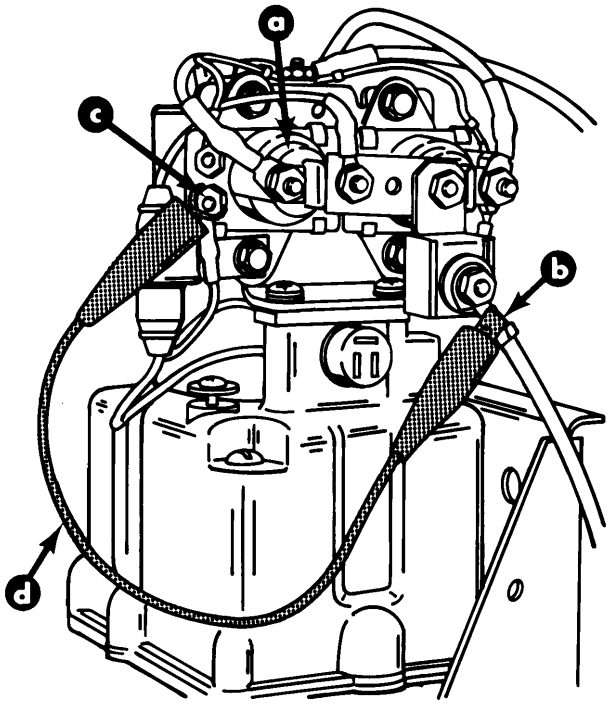
⚠WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

⚠CAUTION

Remain clear of drive unit when performing power trim pump motor tests with pump in boat and hydraulic hose connected.

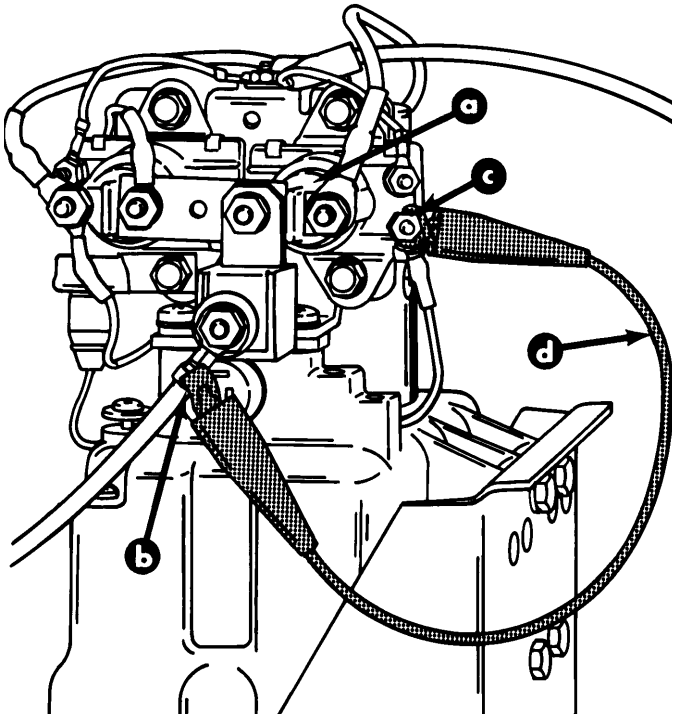
1. UP/OUT Solenoid:
   a. Connect jumper wire between positive (+) solenoid terminal and BLUE/WHITE harness wire terminal.
   b. Motor should run.



50521

a - OUT/UP Solenoid
b - Positive (+) Terminal
c - BLUE/WHITE Harness Wire Terminal
d - Jumper Wire

2. IN/DOWN Solenoid:
   a. Connect a jumper wire between positive (+) solenoid terminal and GREEN/WHITE harness wire terminal.
   b. Motor should run.



50521

a - IN/DOWN Solenoid
b - Positive (+) Terminal
c - GREEN/WHITE Harness Wire Terminal
d - Jumper Wire

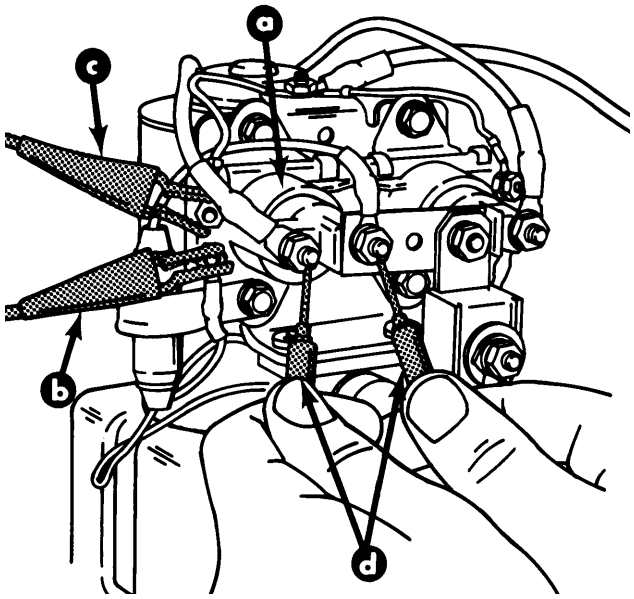
3. If motor does not run in one direction or another, replace appropriate solenoid. (See Wiring Diagram at end of this section for wire connection points).

Solenoid Test (Pump Out of Boat)

⚠ WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

1. Remove trim pump from boat. Refer to "Trim Pump Removal." See Table of Contents.
2. Remove fluid from trim pump reservoir.
3. OUT/UP Solenoid:
   a. Connect 12 volt positive (+) supply lead to BLUE/WHITE harness wire terminal.
   b. Connect negative (-) supply lead to solenoid ground terminal.
   c. Connect ohmmeter leads to large terminals on solenoid.



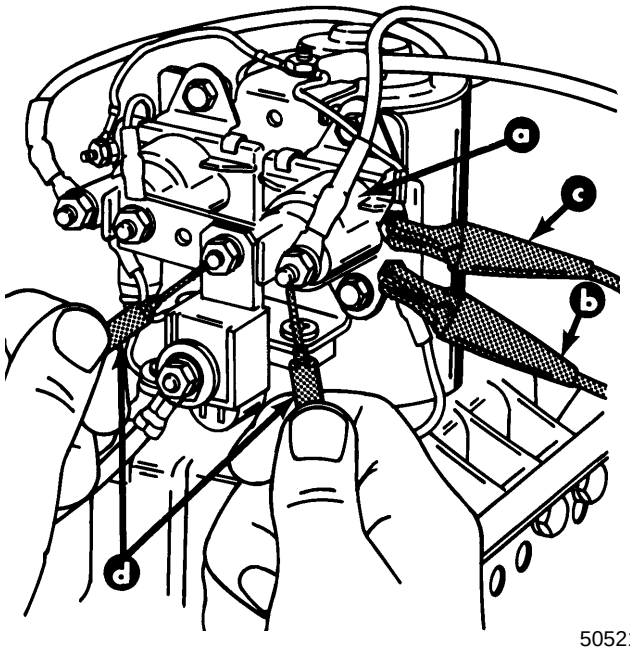
50521

a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead
d - Ohmmeter Leads

4. **Zero Ohms Reading (Full Continuity):** Solenoid is OK.

   High Ohms Reading (No Continuity): Replace solenoid.

5. IN/DOWN Solenoid:
   a. Connect 12 volt positive (+) supply lead to GREEN/WHITE harness wire terminal.
   b. Connect negative (-) supply lead to solenoid ground terminal.
   c. Connect ohmmeter leads to large terminals on solenoid.



50521

a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (-) Supply Lead
d - Ohmmeter Leads

6. **Zero Ohms Reading (Full Continuity):** Solenoid is OK.

   High Ohms Reading (No Continuity): Replace solenoid.

See Wiring Diagram at the end of this section for wiring connection points.

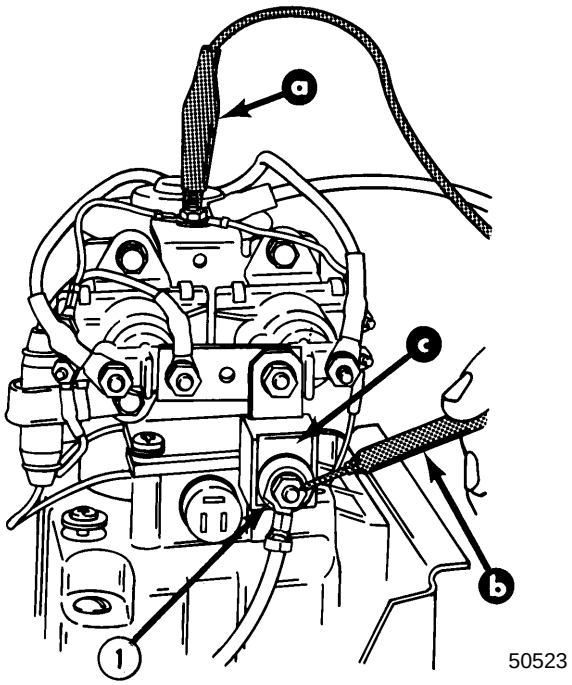
110 Amp Fuse Test (Pump in Boat)

⚠ WARNING

DO NOT perform this test near flammables (or explosives), as a spark may occur when making connections.

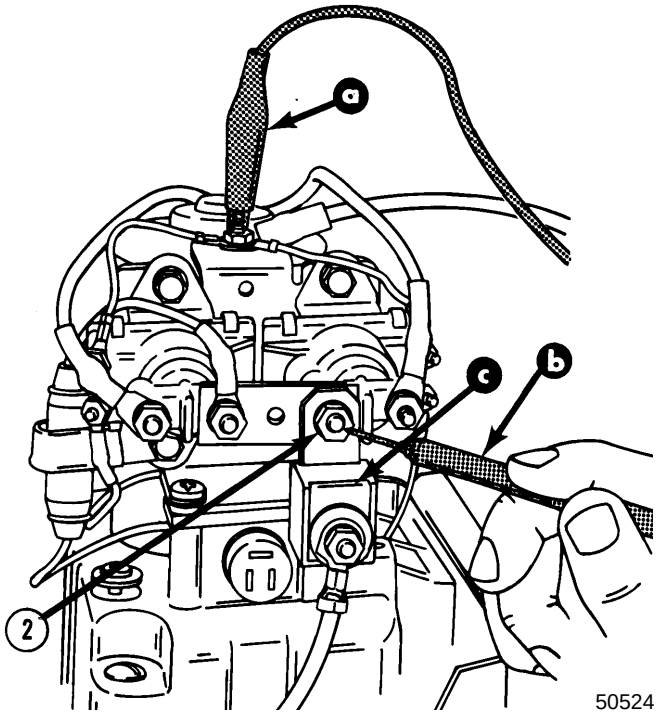
1. Check for voltage at terminal “1” using a volt meter. Voltage MUST BE indicated before proceeding with next check.
2. Check for voltage at terminal “2,” using volt meter.

Voltage Indicated: Fuse OK.
Voltage Not Indicated: Replace fuse.



50523

a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse



50524

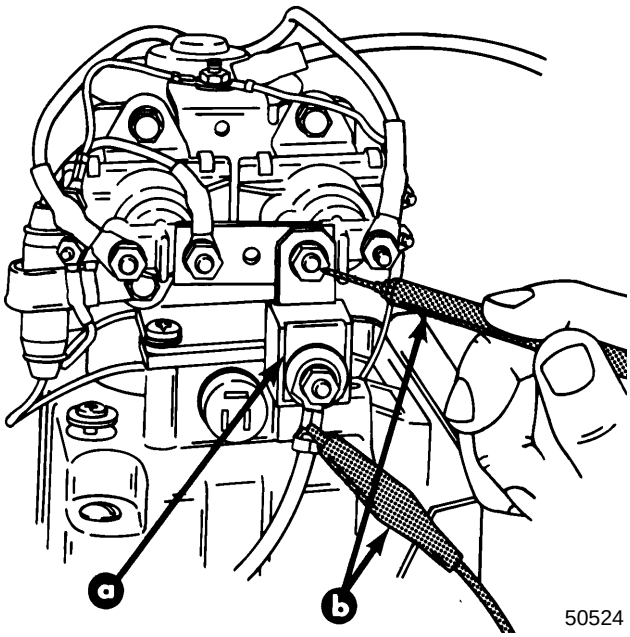
a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse

110 Amp Fuse Test (Pump Out of Boat)

1. Connect ohmmeter leads between terminals on fuse.

ZEro Ohms Reading (Full Continuity): Fuse OK

HIGH OHMS READING (No Continuity): Replace fuse

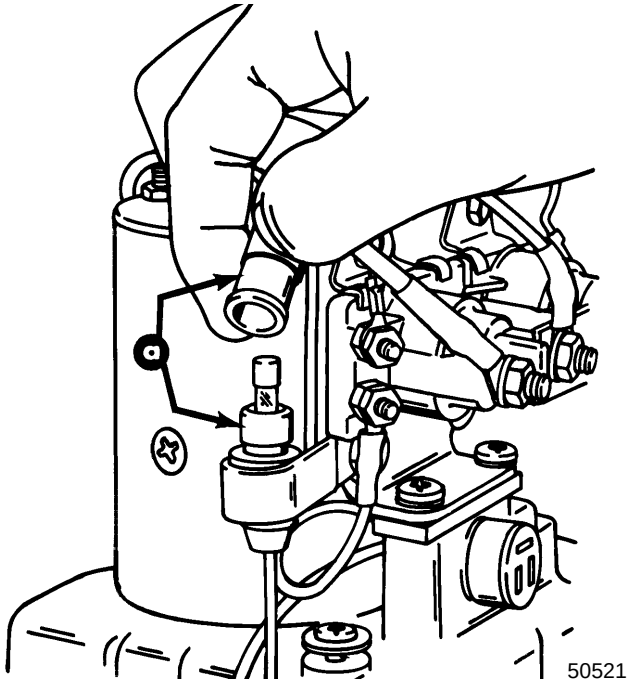


50524

a - 110 Amp Fuse
b - Ohmmeter Leads

20 Amp Fuse Test

1. Remove fuse from fuse holder.



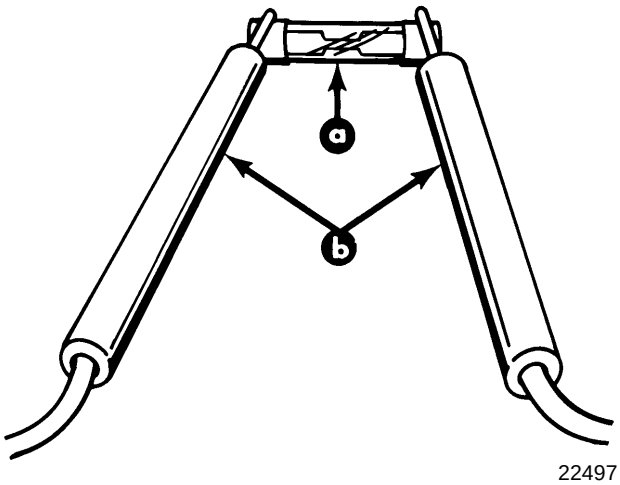
50521

a - Fuse Holder

2. Connect ohmmeter; one lead to each end of fuse.

   Zero Ohms Reading (Full Continuity): Fuse OK.

   HIGH OHMS READING (No Continuity): Replace fuse.

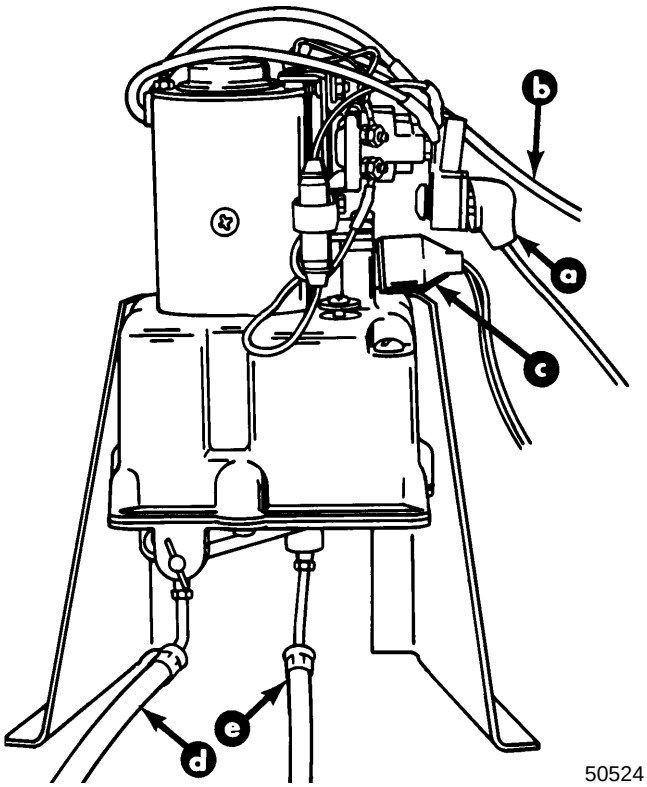


22497

a - 20 Amp Fuse
b - Ohmmeter Leads

Trim Pump Removal

1. Disconnect trim pump battery leads from battery (negative lead first).
2. Disconnect trim harness connector (3 pronged) from trim pump.
3. Remove hydraulic hoses from trim pump. Cap end of hoses.
4. Remove lag bolts and washers, and lift pump and floor bracket from boat.



50524

a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)

Hydraulic Repair

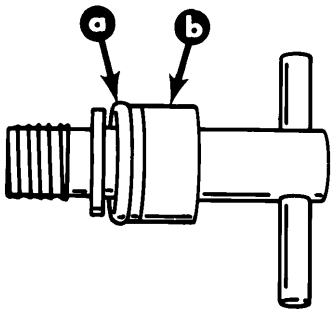
Manual Release Valve Replacement

NOTE: *Replacement of manual release valve can be completed without removing the trim pump from boat.*

⚠WARNING

Before loosening the manual release valve, make sure all people are clear of drive unit as drive unit will drop to full IN/DOWN position when valve is loosened.

Slowly turn manual release valve counterclockwise to remove. To install new valve, turn valve clockwise until it seats.



50461

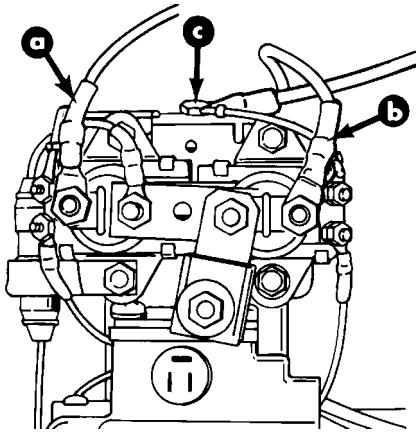
a - O-ring
b - Rubber Seal

Disassembly

⚠CAUTION

Work area must be dirt and lint free. The slightest amount of dirt in hydraulic system can cause pump malfunction.

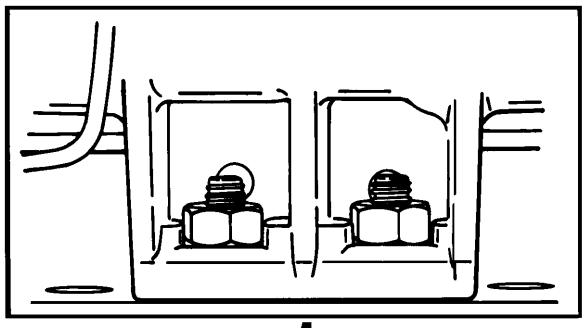
1. Disconnect trim motor wires.



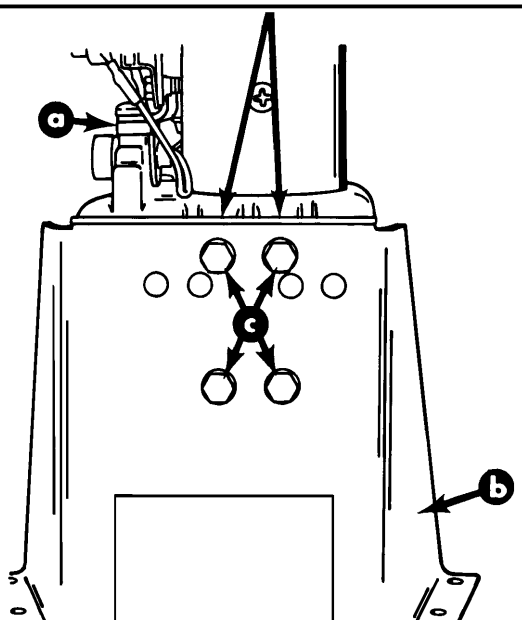
50520

a - BLUE/WHITE Motor Wire
b - GREEN/WHITE Motor Wire
c - BLACK Ground Wires

2. Remove mounting bolts and remove trim pump from floor bracket.



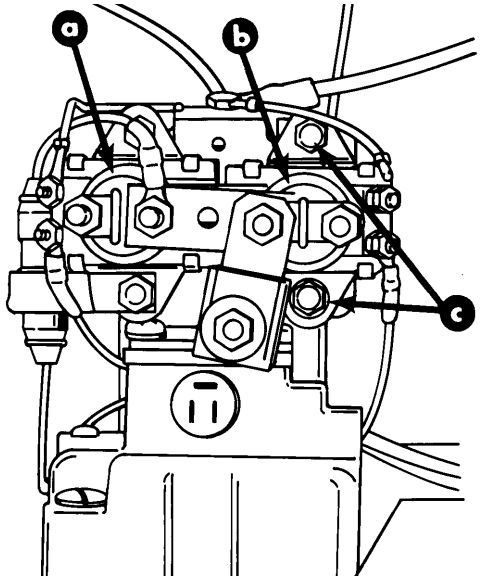
50522



50522

a - Trim Pump
b - Floor Bracket
c - Mounting Bolts

3. Remove solenoids (if replacement is necessary).



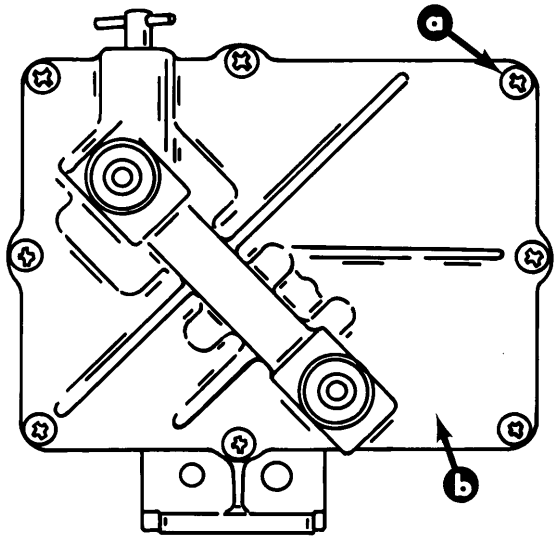
50520

a - UP Solenoid
b - DOWN Solenoid
c - Mounting Bolts (2 On Each Solenoid)

Valve Body and Gear Assembly

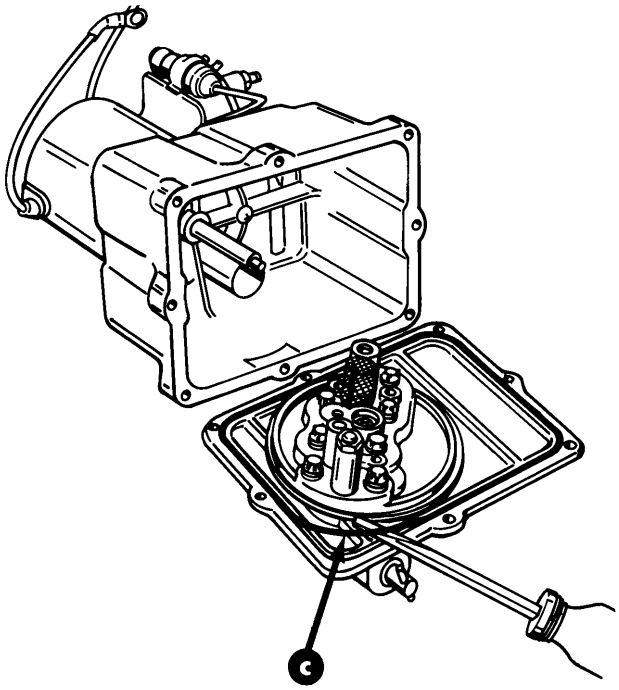
1. Place pump in a container to catch oil when valve body and gear assembly is removed.

2. Remove valve body, gear assembly and seal.



50460

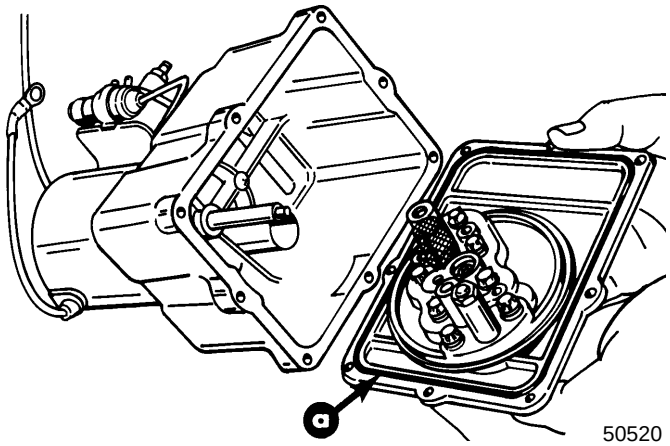
a - Screws (8)
b - Valve Body And Gear Assembly



50520

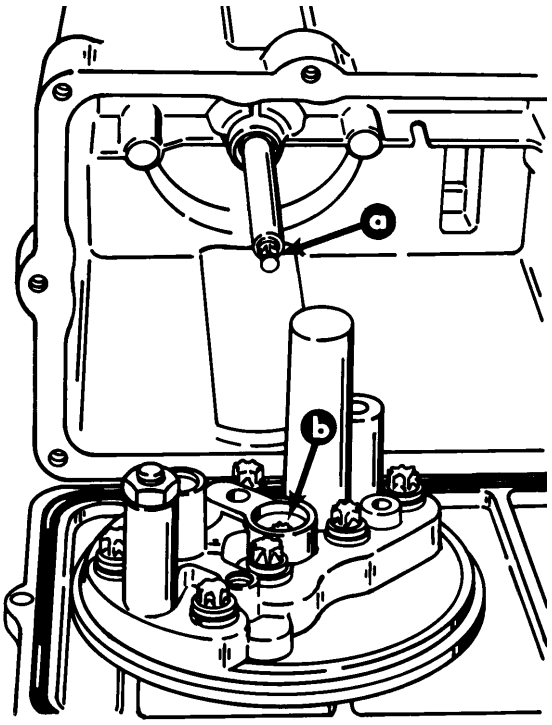
c - Seal

3. Install new seal in reservoir.



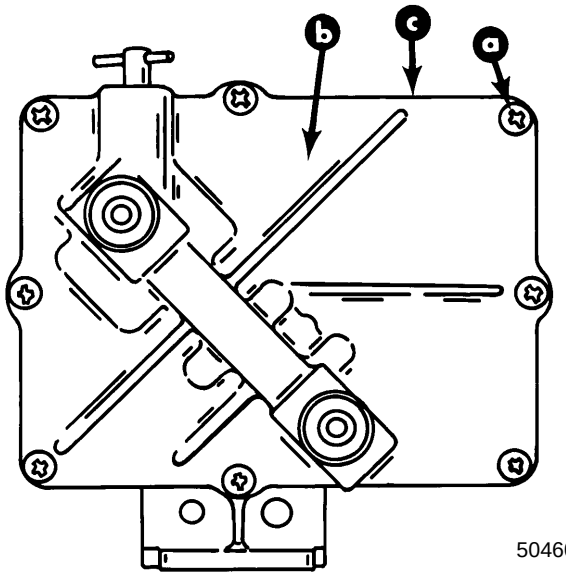
a - Seal

4. Align motor shaft with gear assembly.



a - Motor Shaft
b - Gear Assembly

5. Install valve body and gear assembly.

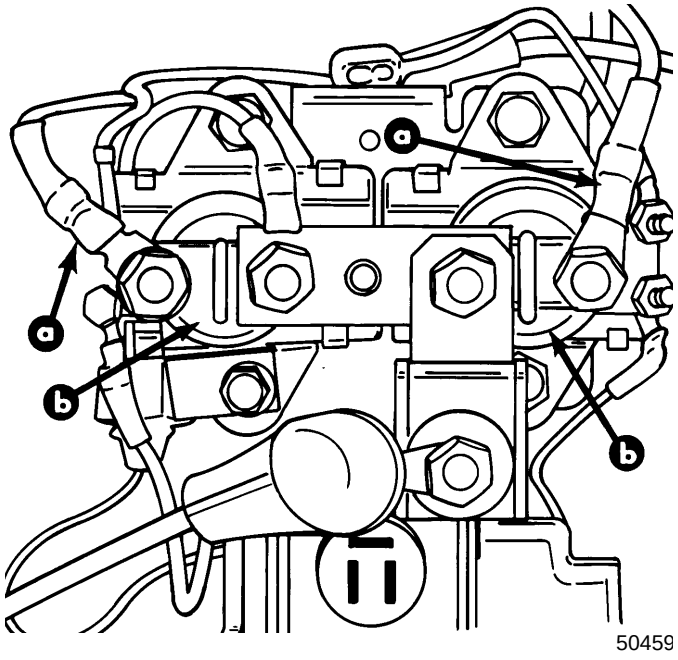


a - Screws (8)
b - Valve Body And Gear Assembly
c - New Seal (Not Seen)

Motor Repair

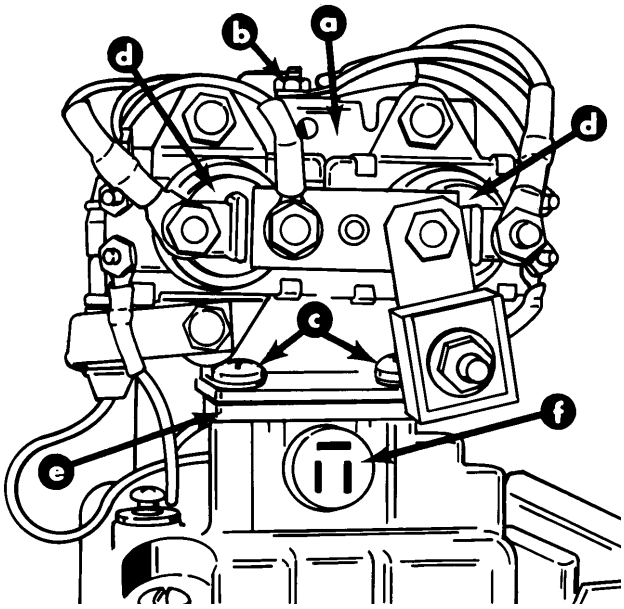
Disassembly

1. Disconnect trim pump motor leads.



a - Trim Pump Motor Leads
b - Solenoids

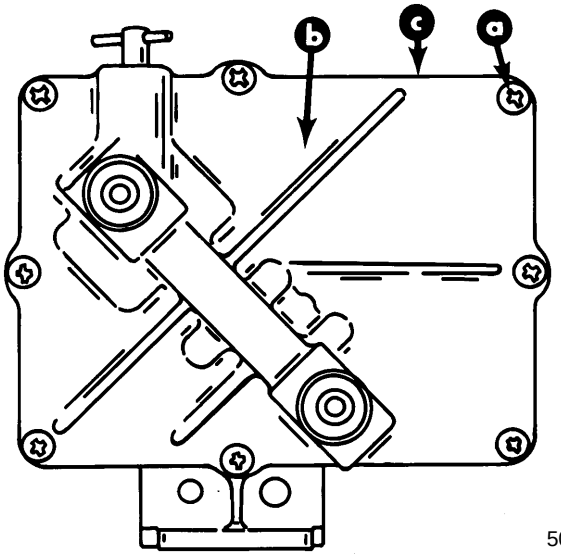
2. Remove solenoid plate and connector and harness.



50459

a - Solenoid Plate
b - Nut
c - Screws
d - Solenoids
e - Spacer
f - Connector and Harness

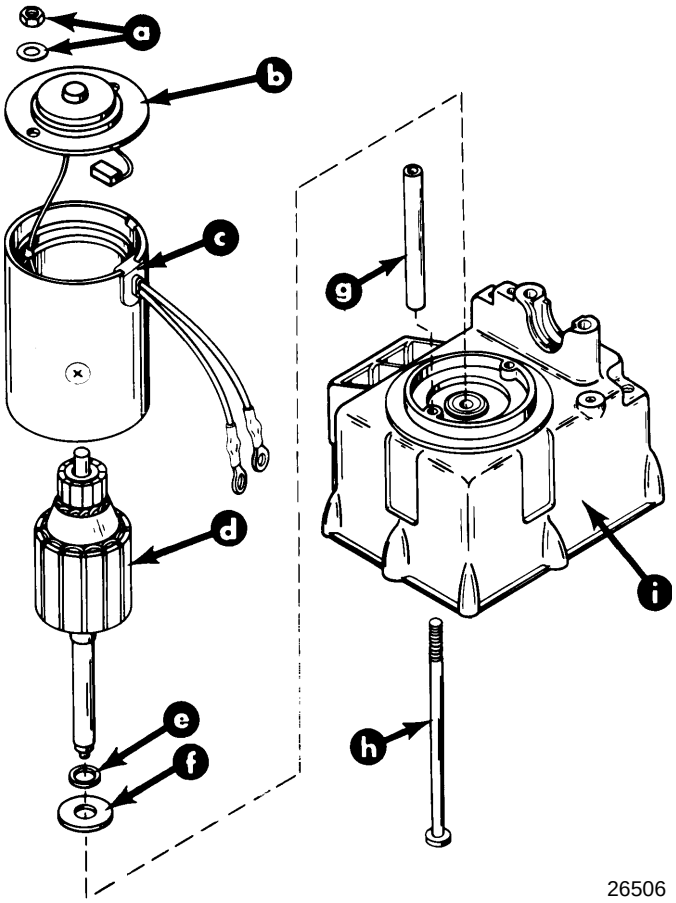
3. Remove valve body and gear assembly.



50460

a - Screws (8)
b - Valve Body And Gear Assembly
c - Seal (Not Seen)

4. Remove motor assembly.



26506

a - Nut And Washer (2)
b - End Plate Assembly
c - Field and Frame Assembly
d - Armature
e - Small Thrust Washer(s)
f - Large Thrust Washer
g - Spacer (1)
h - Studs (2)
i - Reservoir

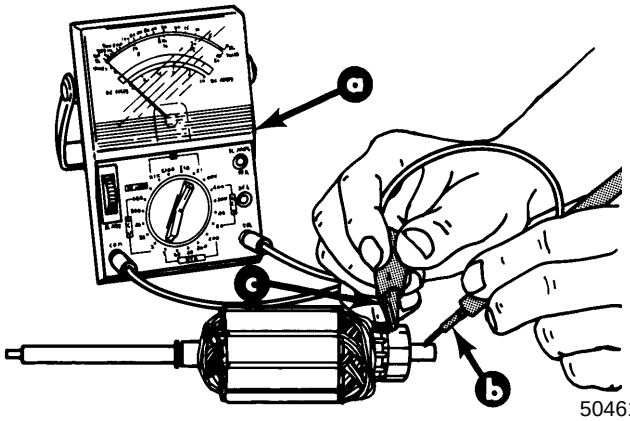
Armature Tests

CONTINUITY TEST

1. Check armature for continuity. Set ohmmeter on Rx1 scale. Connect leads as shown.

Continuity Indicated: Armature is grounded (replace armature).

Continuity Not Indicated: Armature is OK.



50461

a - Ohmmeter
b - Meter Lead - Place On Armature Shaft
c - Meter Lead - Place On All Commutator Bars (One At A Time)

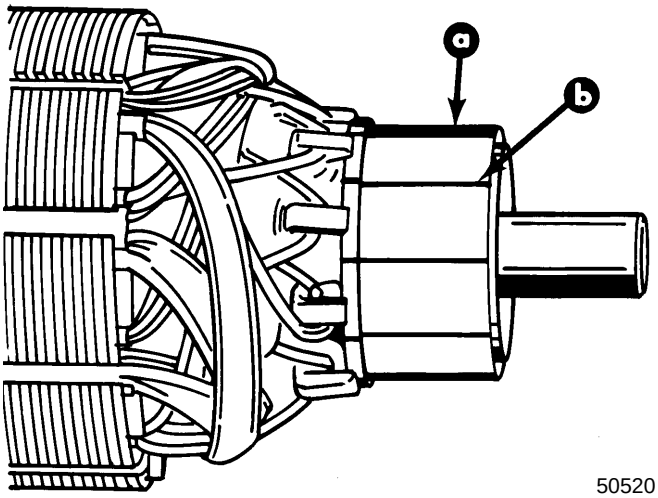
TEST FOR SHORTS

1. Check armature on a growler (follow growler manufacturers instructions). Indication of a short requires replacement.

CLEANING COMMUTATOR

NOTE: *If commutator is worn it can be turned down on a lathe or an armature conditioner tool.*

1. Clean commutator with “00” garnet grit sandpaper. DO NOT use emery paper.
2. Check gaps between commutator bars for material. Remove material if present.



50520

a - Commutator
b - Gap

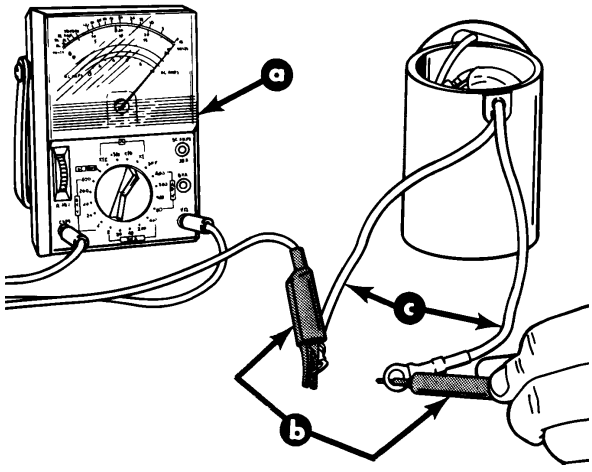
Field Test

TEST FOR OPEN CIRCUIT

1. Set ohmmeter to Rx1 scale and connect meter leads between field leads.

Zero Ohms Indicated (Full Continuity): Field OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.



50461

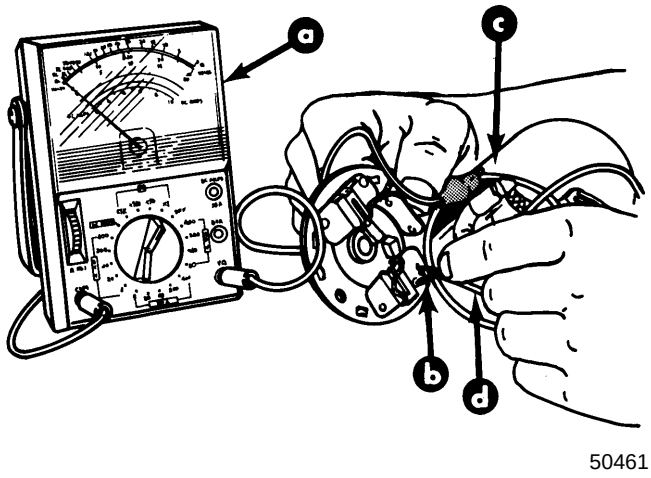
a - Ohmmeter
b - Meter Leads - Connect Between Field Leads
c - Field Leads

TEST FOR SHORT IN FIELD

1. Set ohmmeter on Rx1 scale. Connect ohmmeter between field brush lead and field frame.

Zero Ohms Indicated (full continuity) - Short indicated (Replace field assembly).

Zero Ohms Not Indicated (no continuity) - Field OK.



50461

a - Ohmmeter
b - Meter Lead - Place On Positive Brush Holder Lead
c - Meter Lead - Place On Frame
d - Field Lead

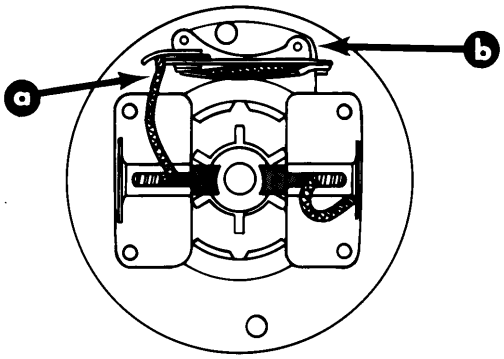
Thermal Switch Test

CONTINUITY TEST

1. Test thermal circuit breaker for continuity, using ohmmeter set on Rx1 scale.

Zero Ohms Indicated (Full Continuity): Thermal switch OK.

Zero Ohms Not Indicated (No Continuity): Replace thermal switch.



26507

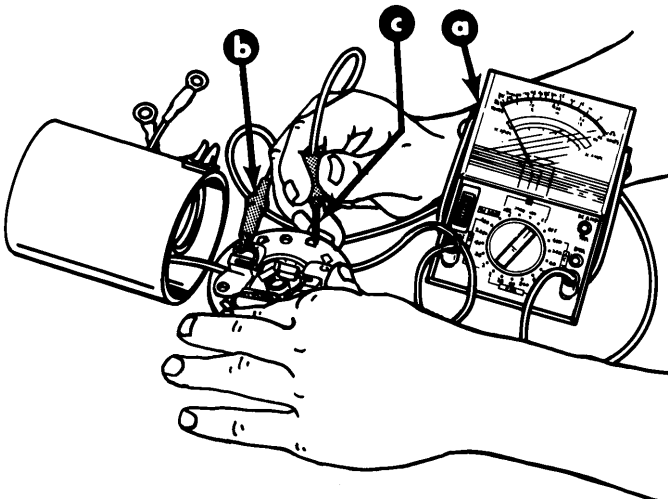
a - Place Meter Lead At This Point
b - Place Meter Lead At Ground

Brush Lead Tests

1. Set ohmmeter on Rx1 scale. Connect leads as shown. Test positive brush lead for ground.

Continuity Indicated: Grounded condition; replace end plate assembly.

No continuity: Brush lead OK.



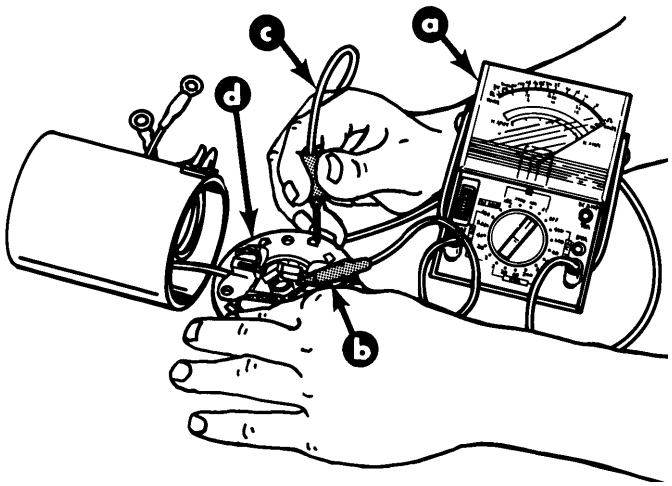
50460

a - Ohmmeter
b - Meter Lead - Place On Positive Brush Lead
c - Meter Lead - Place On End Cap

2. Set ohmmeter on rx1 scale. Connect leads as shown. Test negative brush lead for an open condition.

Continuity Indicated: Brush lead OK.

Continuity NOT Indicated: Inspect lead for a poor connection.



50460

a - Ohmmeter
b - Meter Lead - Place On Negative Brush Lead
c - Meter Lead - Place On End Cap
d - Positive Brush Lead

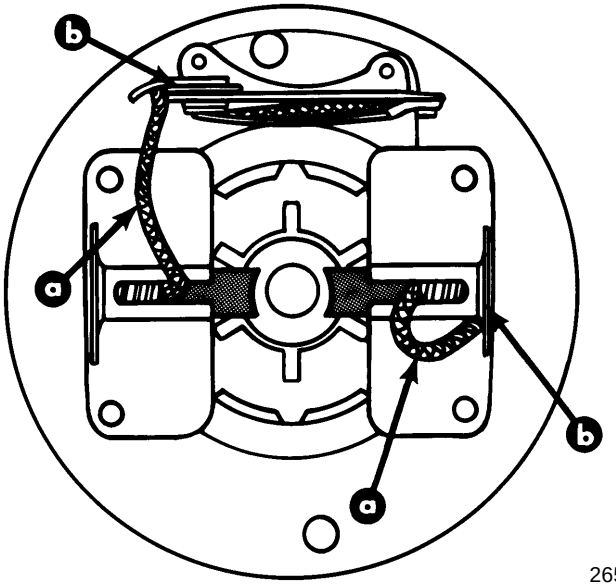
Brush Replacement

Inspect brushes and replace if:

- Pitted
- Chipped
- Brush is less than 1/4 in. (6mm) long
- Leads are fraying

BRUSH REPLACEMENT

1. Cut brush leads off as close to brush holders as possible.
2. Using 70-30 tin-lead alloy rosin core solder, solder new brushes to brush holders.

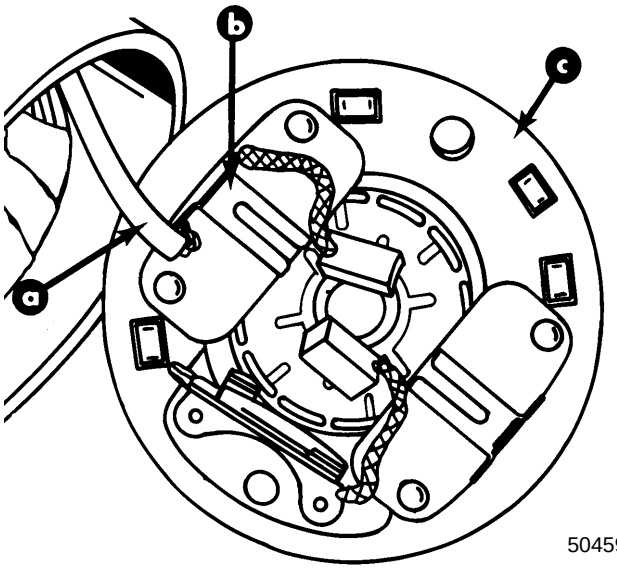


26507

a - Brush Leads
b - Brush Holders

END CAP AND BRUSH ASSEMBLY REPLACEMENT

1. Cut off field to positive brush holder lead as close to brush holder as possible.
2. Using 70-30 tin-lead alloy rosin core solder, solder field lead to brush holder on new end cap.

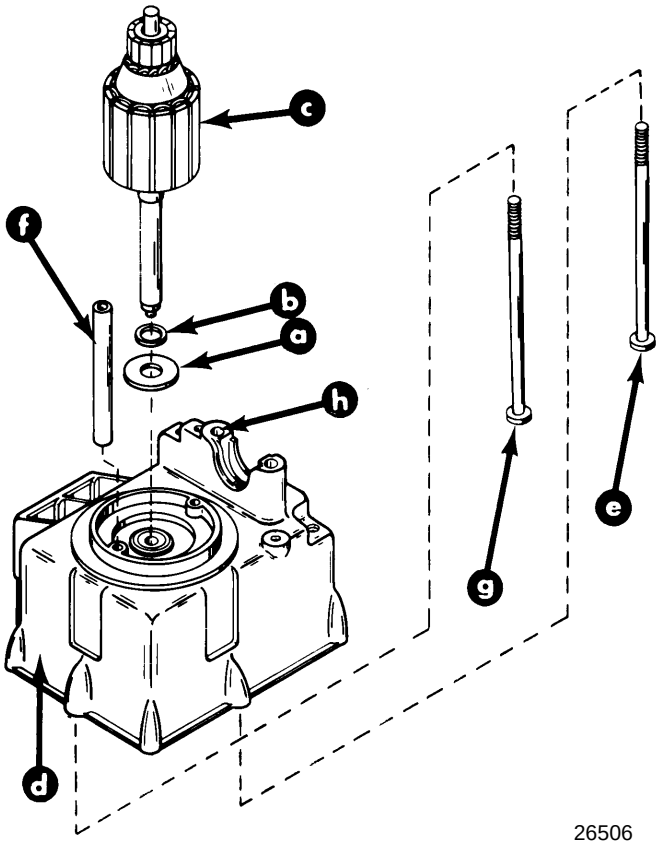


50459

a - Field Lead
b - Positive Brush Holder
c - End Cap

Reassembly

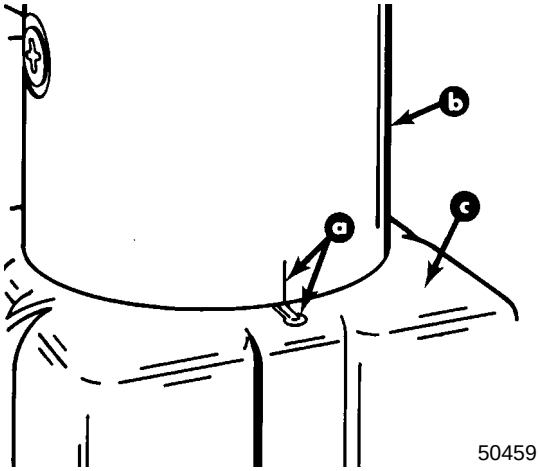
1. Install armature and washers.



26506

a - Large Washer
b - Small Washer(s)
c - Armature
d - Reservoir
e - Long Stud
f - Sleeve (1)
g - Small Stud
h - Connector And Harness Holder

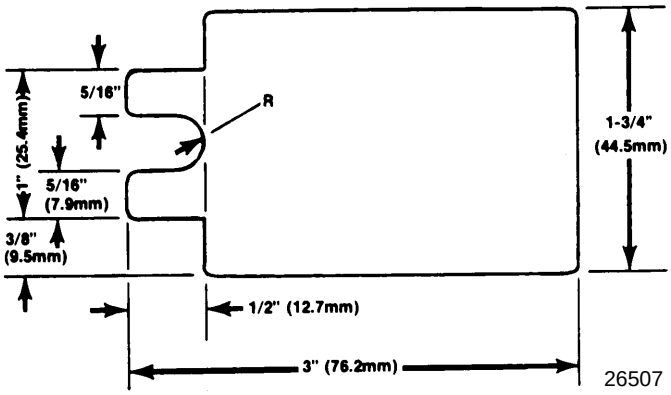
2. Install field and frame assembly. Align index mark on field and frame assembly with mark on reservoir.



50459

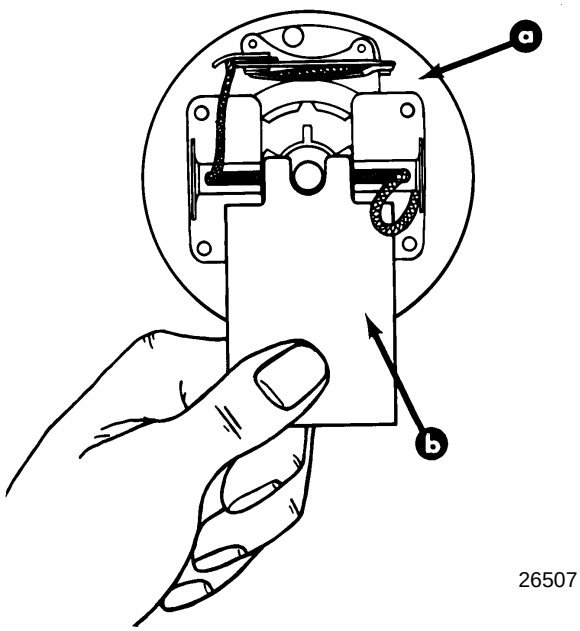
a - Index Marks - Align
b - Field And Frame Assembly
c - Reservoir

NOTE: *Brush holder tool can be made as shown.*



26507

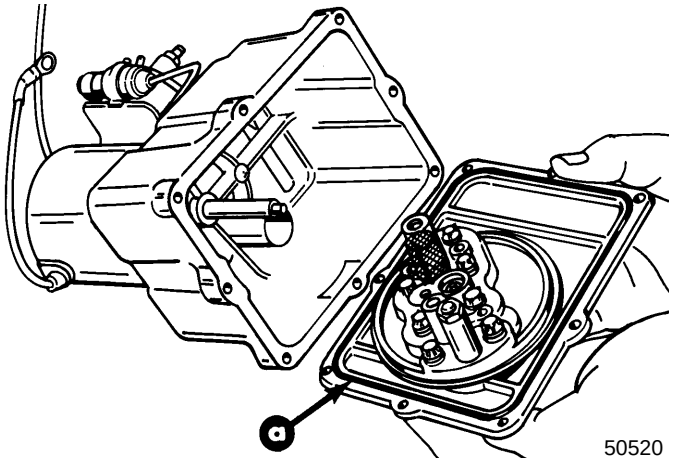
3. Spread brushes with brush holder tool and install end plate over armature. Secure end cap with nuts and washers.



26507

a - End Plate

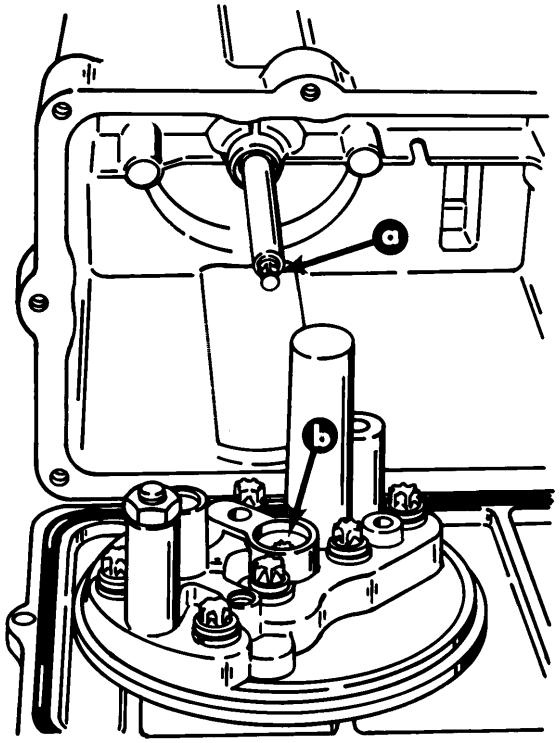
4. Ensure seal is in place in reservoir.



50520

a - Seal

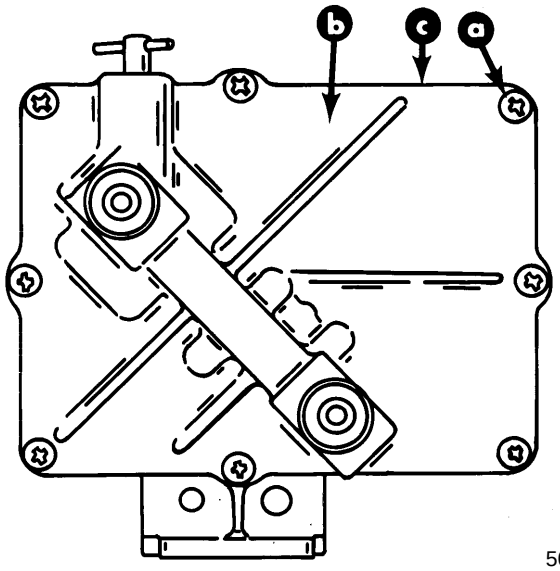
5. Align motor shaft with gear assembly.



50522

a - Motor Shaft
b - Gear Assembly

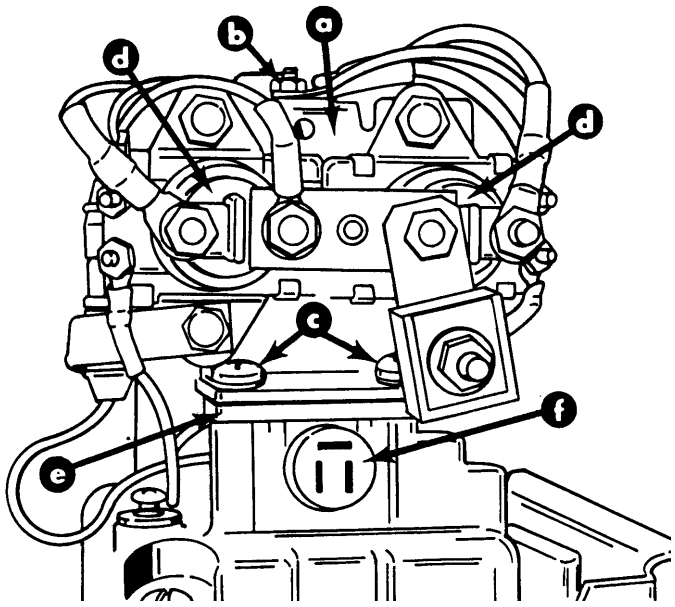
6. Install valve body and gear assembly.



50460

a - Screws (8)
b - Valve Body and Gear Assembly
c - New Seal (Not Seen)

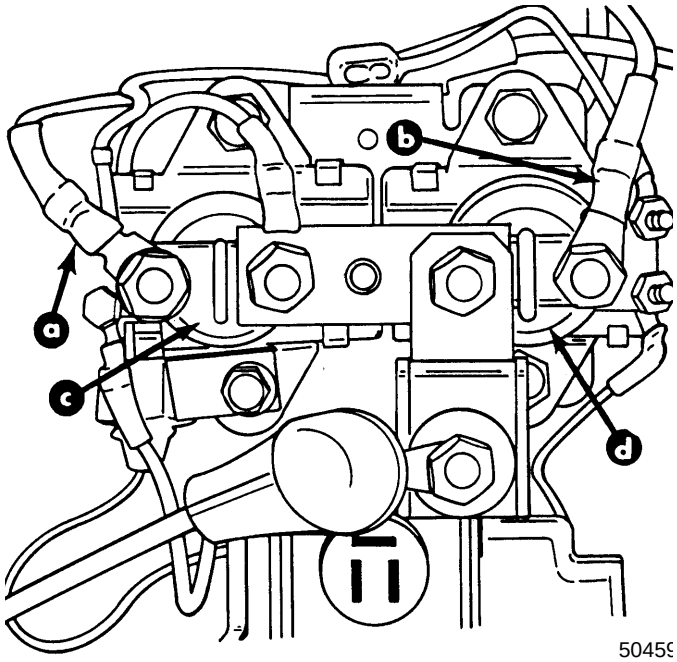
7. Install solenoid plate and connector and harness.



50459

a - Solenoid Plate
b - Nut
c - Screws
d - Solenoids
e - Spacer
f - Connector And Harness

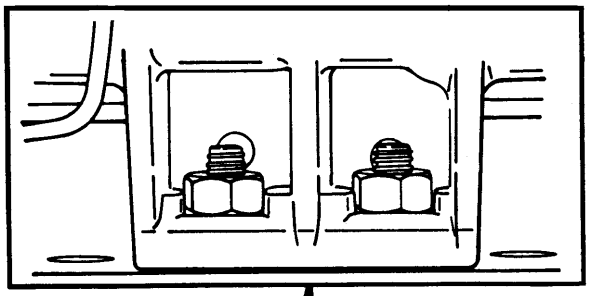
8. Secure trim pump motor leads to solenoids.



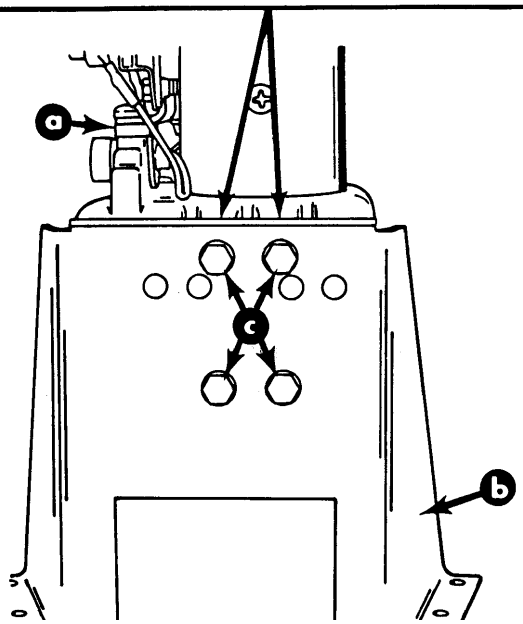
50459

a - Blue Lead - Connect to OUT/UP Solenoid
b - Green Lead - Connect to IN/DOWN Solenoid
c - OUT/UP Solenoid
d - IN/DOWN Solenoid

9. Install trim pump on floor bracket. Tighten securely.



50522

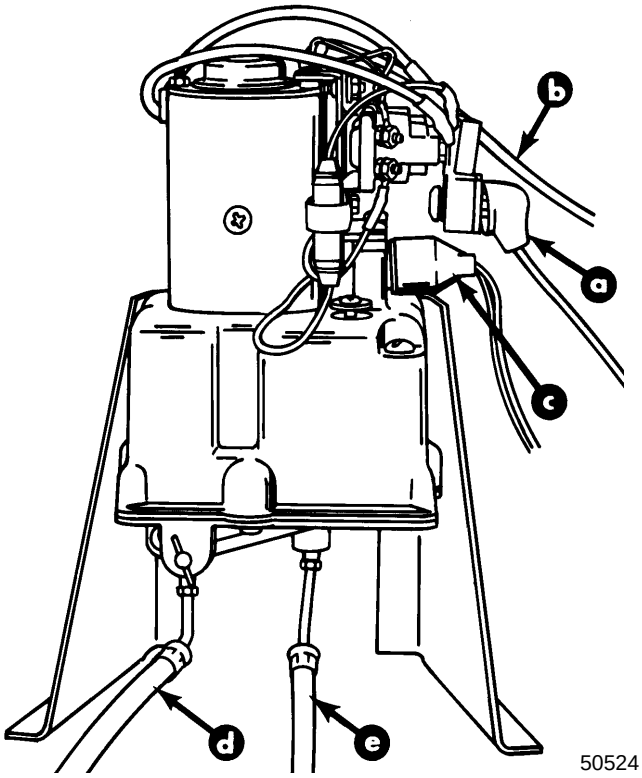


50522

a - Trim Pump
b - Floor Bracket
c - Screws and Lock Washers

Trim Pump Installation

1. Secure pump and mounting bracket to boat using lag bolts and washers.
2. Reconnect trim hoses to pump. Black hose to left connection; gray hose to right connection. DO NOT cross-thread or overtighten hose fittings. Torque to 70 - 150 lb. in. (7.9 - 16.9 N•m).
3. Reconnect trim harness connector to trim pump.
4. Reconnect battery leads to battery.
5. Check fluid level and fill if necessary. (Refer to “Maintaining Power Trim Pump Oil Level” in this section.)

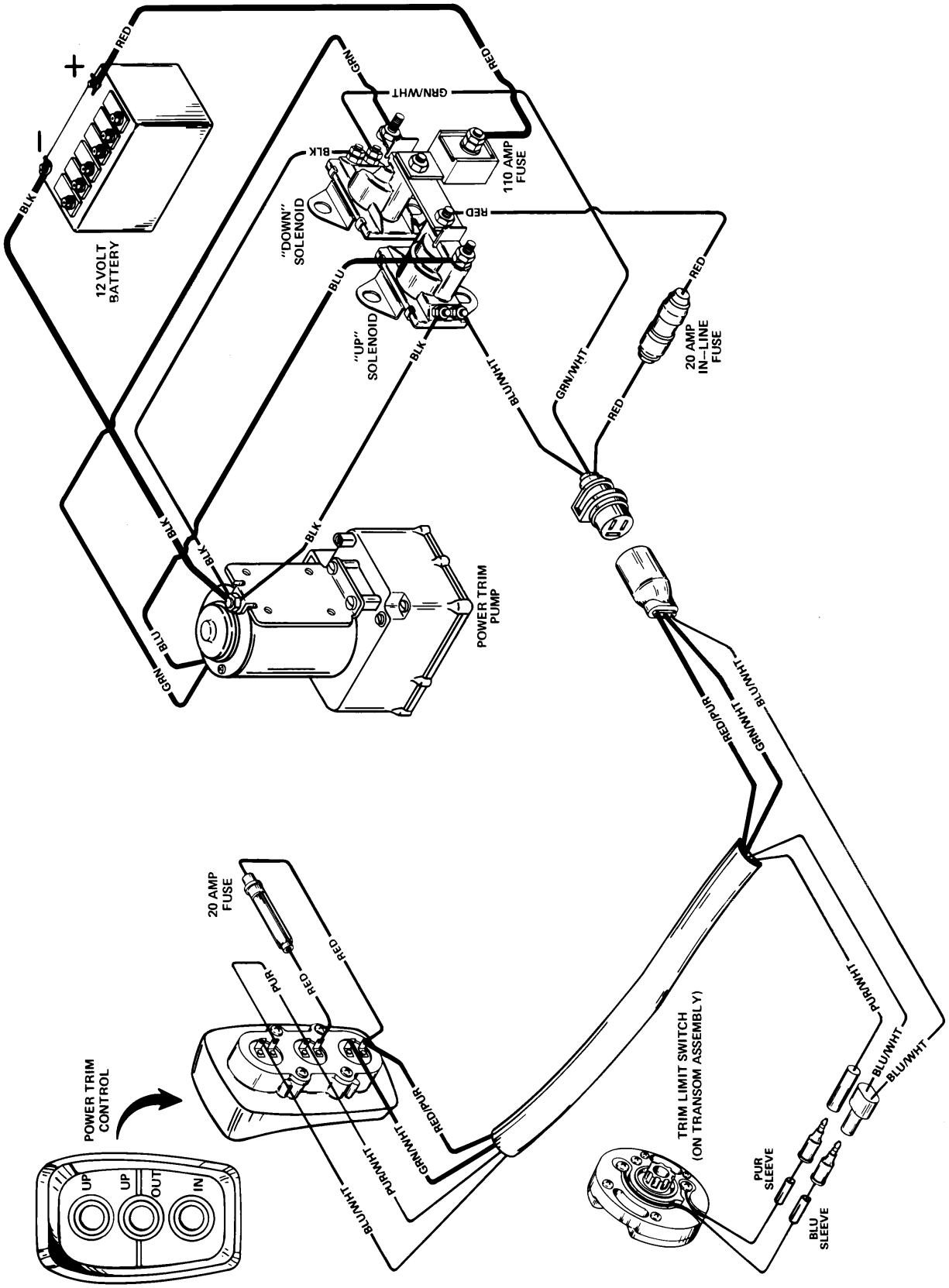


50524

a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)

Wiring Diagram

26347



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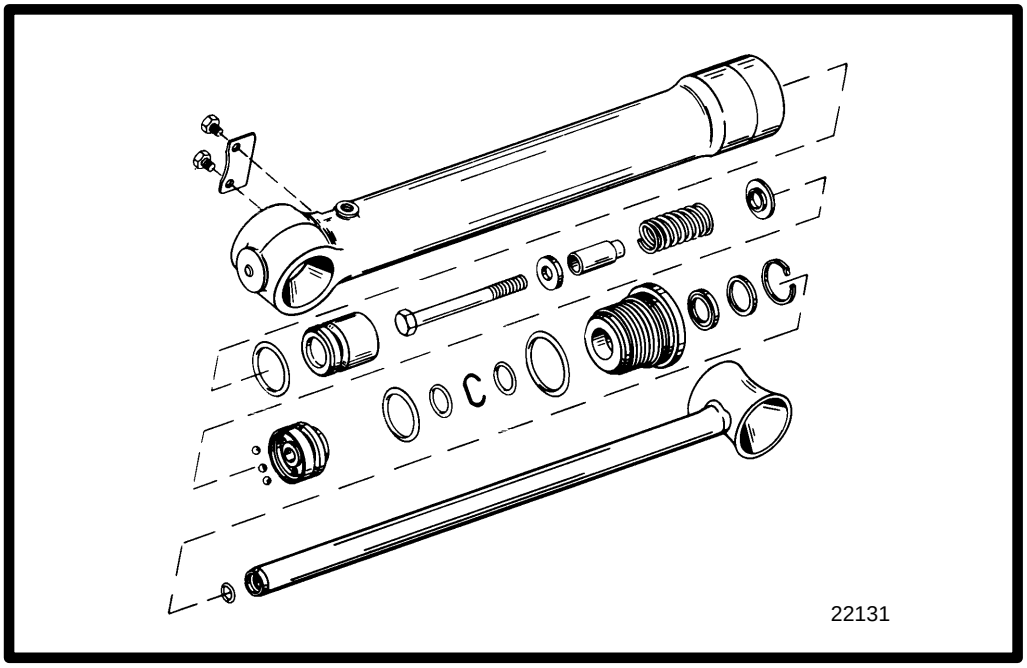
POWER TRIM



5

D

TRIM CYLINDERS

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Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Piston Rod Bolt		15-20	20-27
Trim Cylinder Anchor Pin Bolts	Tighten Until Nuts Bottom On Anchor Pin Shoulder		
End Cap		40-50	55-68

Lubricants/Sealers/ Adhesives

NOTE: *Prior to reassembly of trim cylinder(s), lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or (if not available) 10W-30 or 10W-40 motor oil.*

Description	Part No.
Loctite 27131	92-809820
Quicksilver 2-4-C Marine Lubricant	92-825407A2
Quicksilver Perfect Seal	92-34227--1
Quicksilver Power Trim and Steering Fluid	92-90100A12

Special Tools

Description	Part Number
Spanner Nut Wrench	91-821709
Large Pin Set	91-811907
Medium Pin Set	91-811908
Small Pin Set	91-811909

Trim Cylinder Internal Leak Test

Refer to Power Trim Pump Sec. 5A, 5B, or 5C.

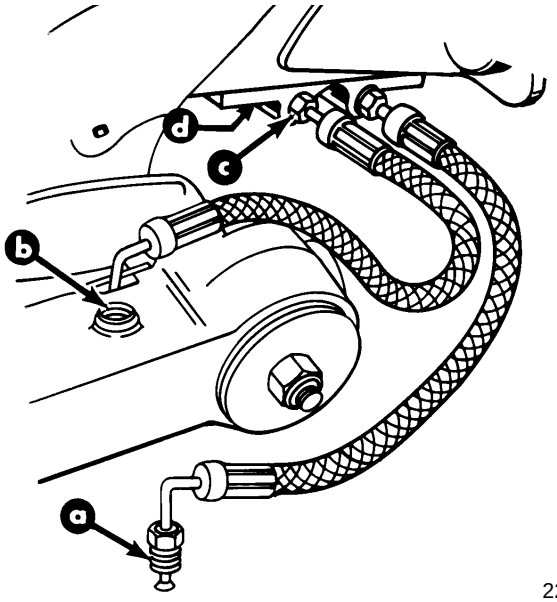
Trim Cylinder Shock Piston Test

Refer to Power Trim Pump Sec. 5A, 5B, or 5C.

Trim Cylinder Repair

Removal

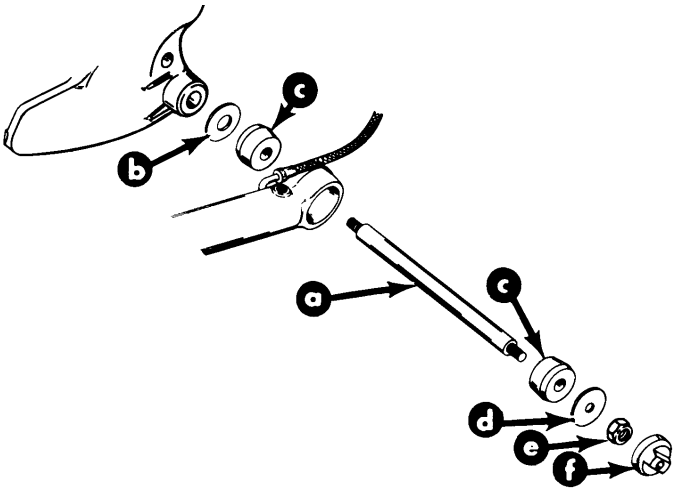
1. Disconnect UP trim hose from front hole on trim cylinder.
2. Disconnect DOWN trim hose from hydraulic connector on gimbal housing. Plug holes with suitable plug or (P/N 22-38609).



22089

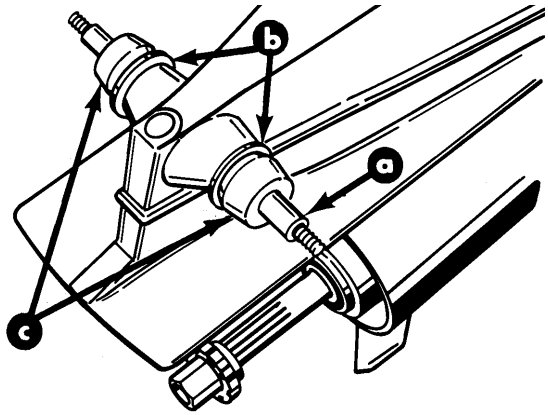
a - UP Hose
b - Front Hole On Trim Cylinder
c - DOWN Hose
d - Hydraulic Connector

3. Remove front and rear power trim cylinder mounting hardware.

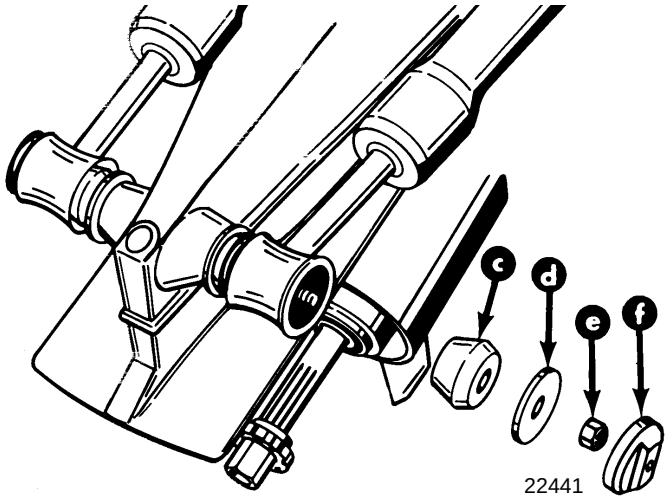


22133

a - Front Anchor Pin
b - Large I.D. Washers (Port And Starboard)
c - Rubber Bushings (2) (Port And Starboard)
d - Small I.D. Washers (Port And Starboard)
e - Locknuts (Port And Starboard)
f - Plastic Caps (Port And Starboard)



22060



22441

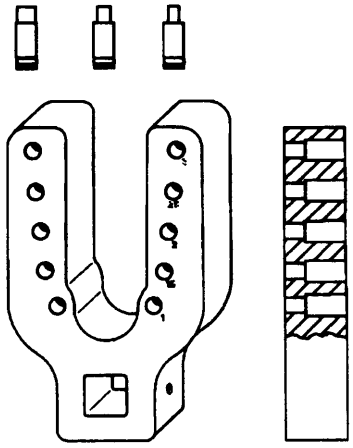
a - Rear Anchor Pin
b - Large I.D. Washers (Port And Starboard)
c - Rubber Bushings (2) (Port And Starboard)
d - Small I.D. Washers (Port And Starboard)
e - Locknuts (Port And Starboard)
f - Plastic Caps (Port And Starboard)

DISASSEMBLY

⚠ CAUTION

Ensure work area is clean before disassembling power trim cylinders. Cylinder parts can be damaged by dirt entering into power trim system.

NOTE: *Spanner Wrench Quicksilver Tool Part Number 91-821709.*

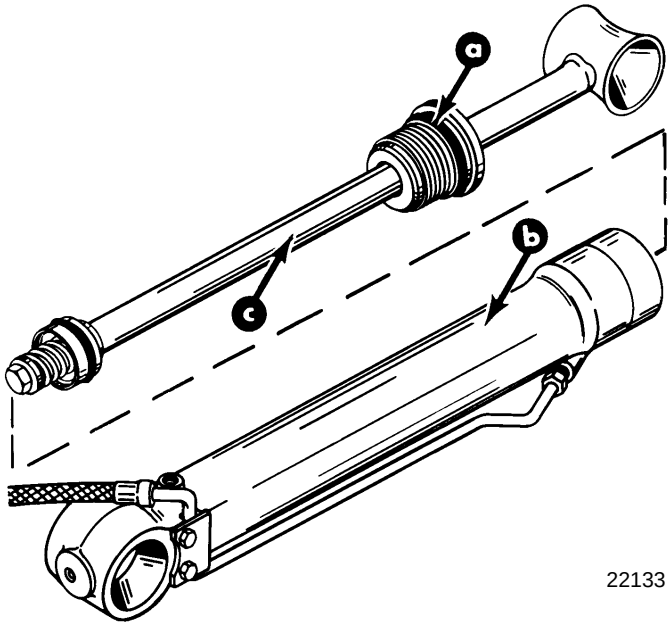


71233

⚠ CAUTION

DO NOT clamp center section of power trim cylinder during assembly or disassembly. If clamping cylinder is necessary, clamp cylinder on front mounting flange.

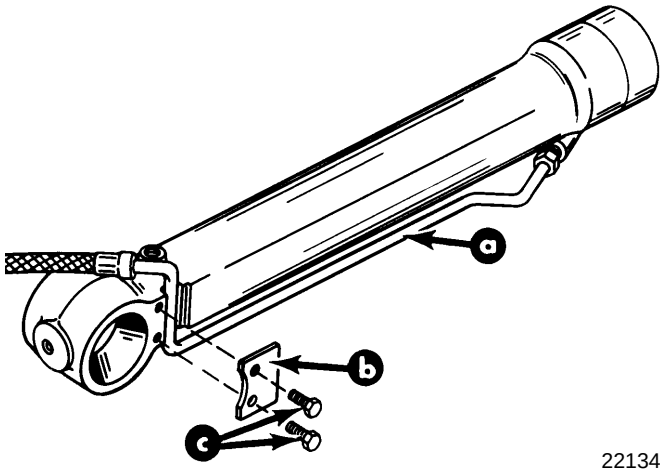
1. Loosen end cap with Quicksilver P/N 91-821709 spanner wrench and remove piston rod assembly from cylinder.



22133

a - End Cap
b - Cylinder
c - Piston Rod Assembly

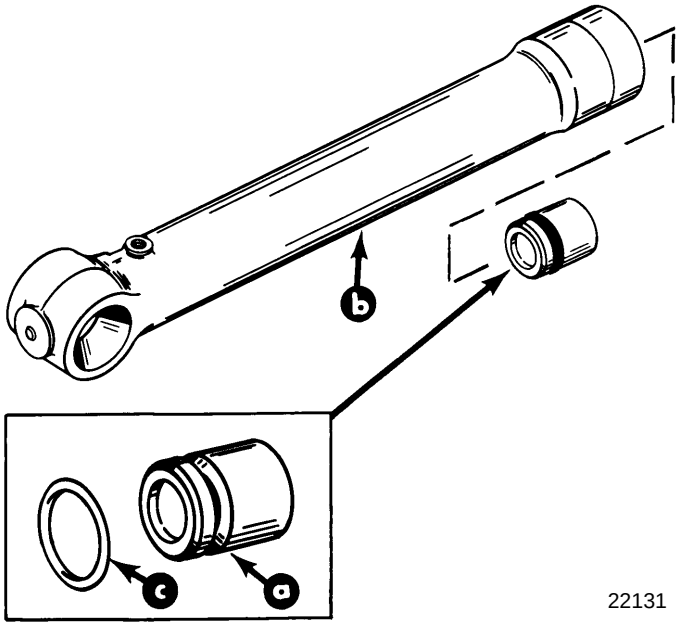
2. Remove DOWN trim hose from cylinder.



22134

a - DOWN Trim Hose
b - Clamping Plate
c - Screws

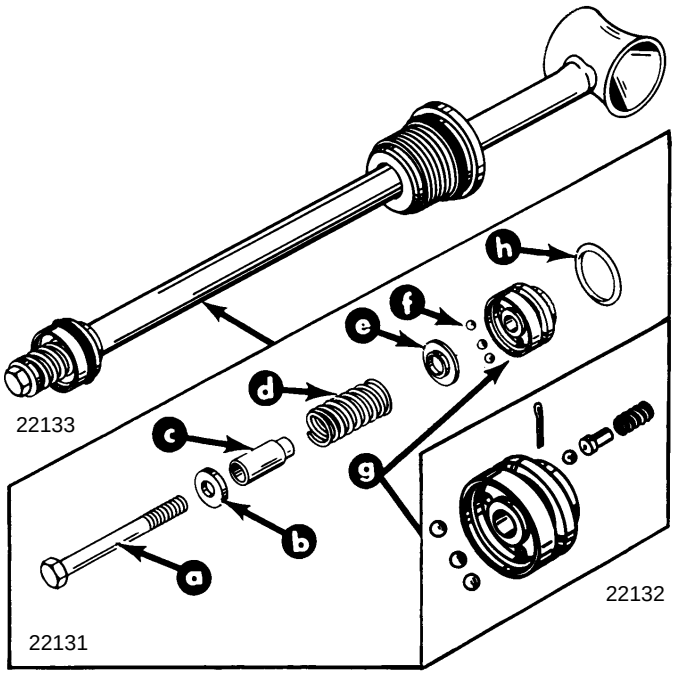
3. Remove floating piston from cylinder and remove O-ring.



22131

a - Floating Piston
b - Trim Cylinder
c - O-Ring

4. Remove and disassemble shock piston assembly. Be careful not to loose check balls.



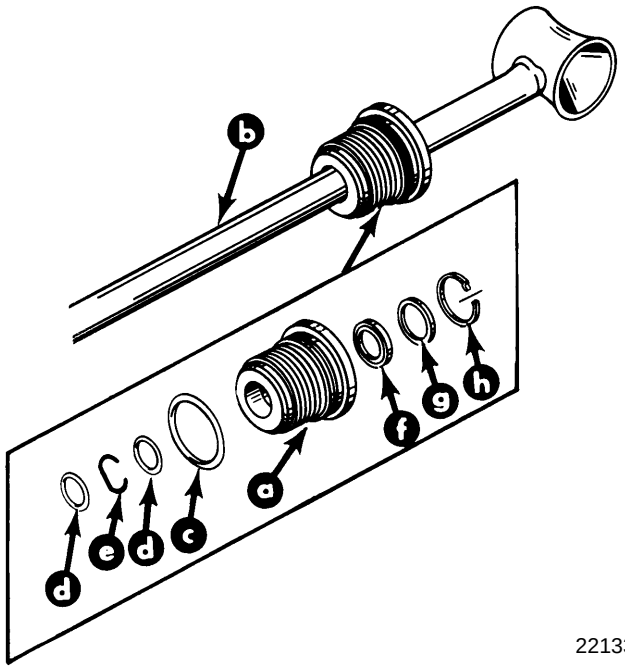
22133

22132

22131

a - Bolt
b - Flat Washer
c - Spring Guide
d - Spring
e - Spring Guide Washer
f - Check Balls (3)
g - Shock Piston Assembly
h - O-Ring

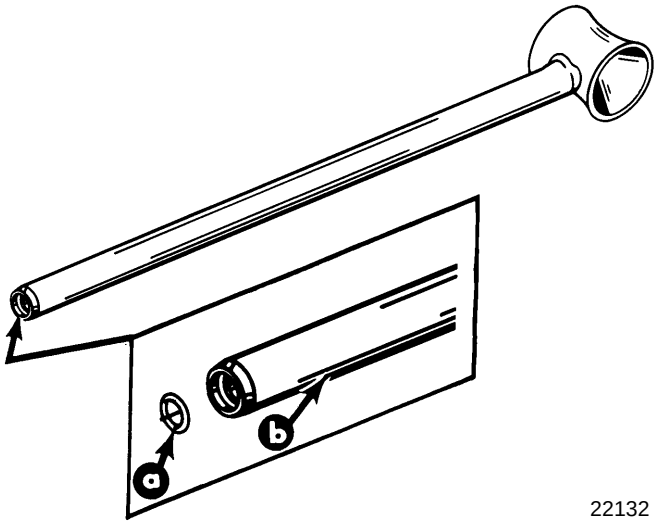
5. Remove and disassemble end cap.



22133

a - End Cap
b - Piston Rod
c - Large O-Ring
d - Small O-Ring (2)
e - Continuity Spring
f - Rod Scraper
g - Plain Washer
h - Retaining Ring

6. Remove small o-ring from end of piston rod.



22132

a - Small O-Ring
b - Piston Rod

7. Clean all parts in solvent. Be sure all parts are dry before reassembly.

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Reassembly

IMPORTANT: Later model Alpha One drive units use a trim cylinder that is $^{3}/_{4}$ in. (19mm) longer, to achieve 6° additional tilt. Earlier model R, MR and Alpha One, as well as Bravo drive units, use the shorter trim cylinder. DO NOT attempt to substitute trim cylinders or damage to drive unit and/or transom assembly could result.

Trim cylinders can be identified by a casting number on inboard side of trim cylinder.

Shorter Cylinder: 98703, 98704, 98703--1, 98704--1

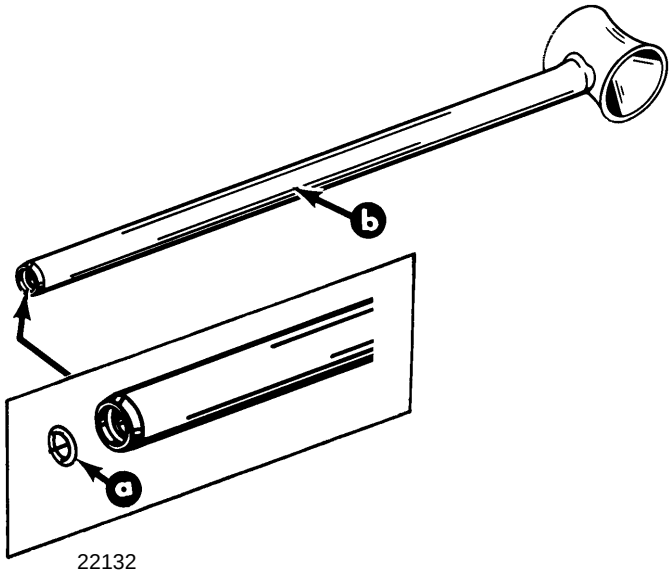
Longer Cylinder: 14034--1,14035--1

⚠ CAUTION

Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

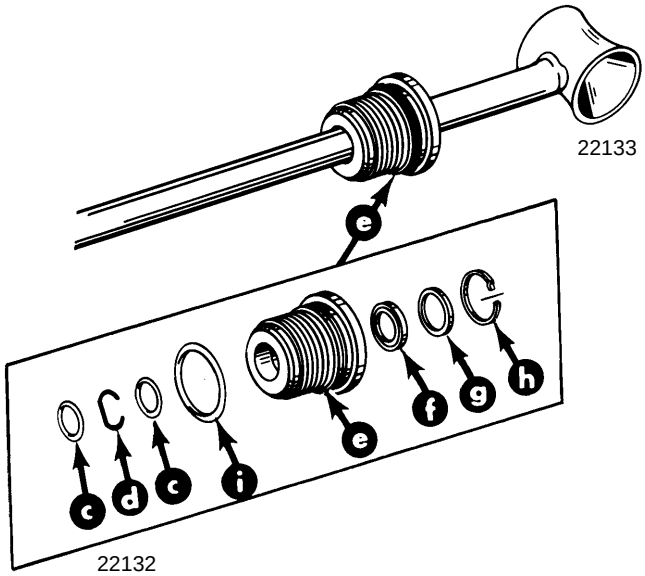
NOTE: *Before reassembly, lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 Motor Oil.*

1. Install small o-ring (a) into end of piston rod (b).

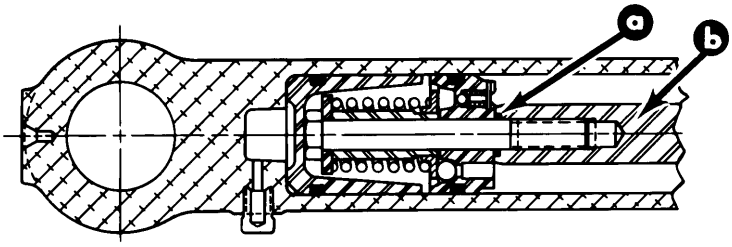


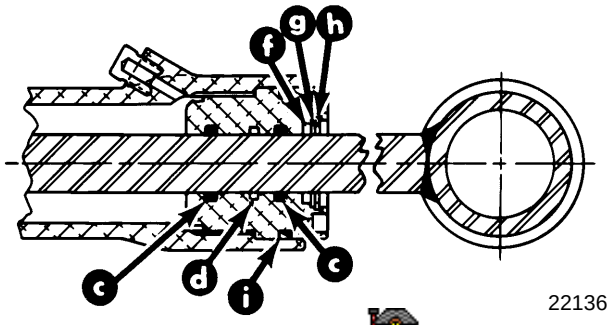
22132

2. Install small o-rings (c) and continuity spring (d) into end cap (e).
3. Install rod scraper (f), plain washer (g) and retaining ring (h) into end cap (e).
4. Install large o-ring (i) onto outside diameter of end cap (e).
5. Install end cap (e) onto piston rod.



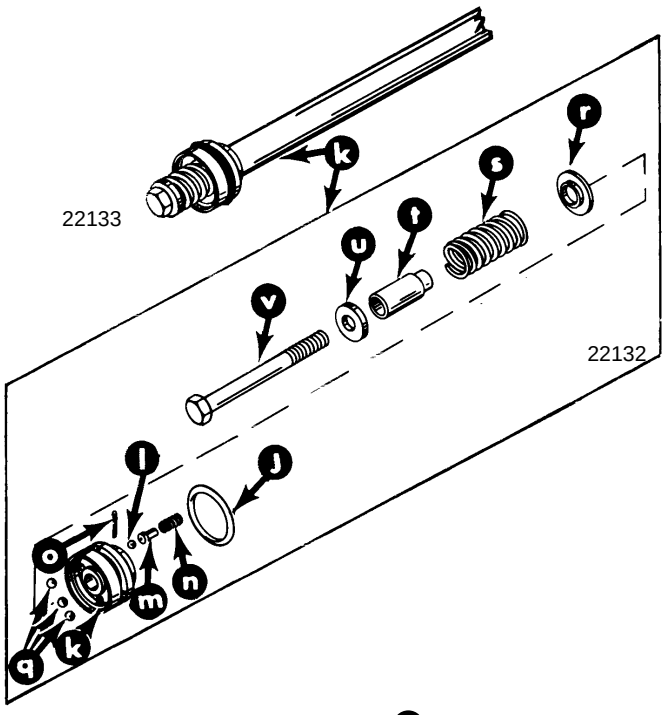
22133 22132



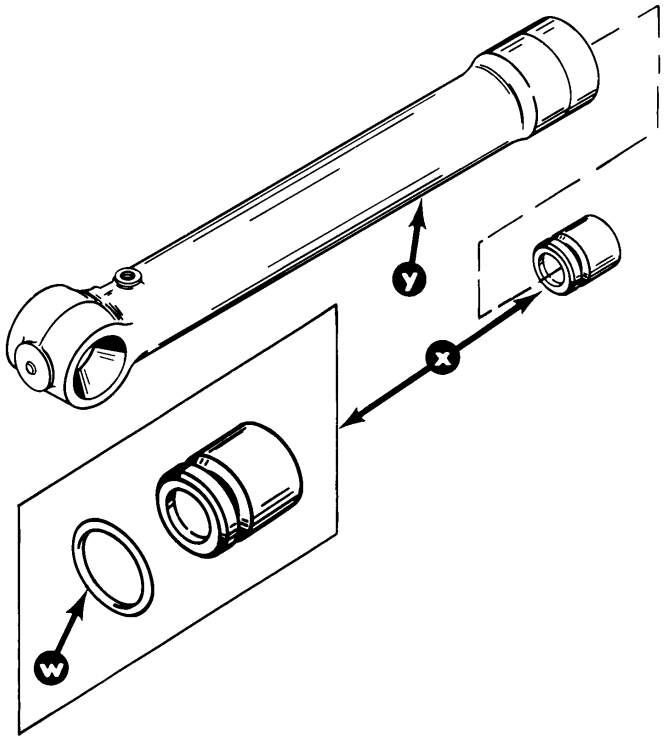


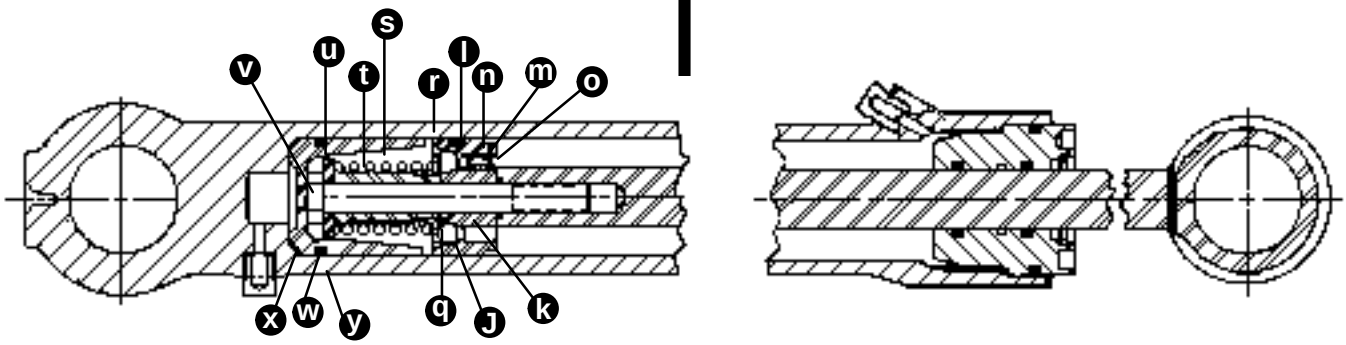
22136

6. Install large O-ring (j) on shock piston (k).
7. Install check ball (l), check ball eyelet (m), spring (n) and spring pin (o) into shock piston.
8. Apply Loctite 27131 or Type “A” to threads of bolt being used in the following step.
9. Install shock piston, three check balls (q), spring guide washer (r), spring (s), spring guide (t), spring guide washer (u) and bolt (v) onto piston rod. Torque to 15-20 lb. ft. (20-27 N·m).



10. Apply oil to parts. Install o-ring (w) onto floating piston (x) and insert floating piston into cylinder (y).





⚠CAUTION

Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

NOTE: *Before reassembly, lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil.*

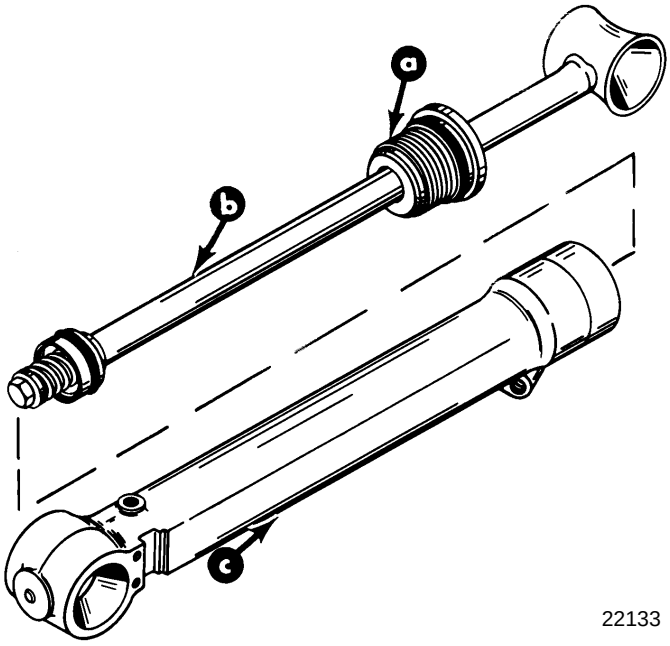
⚠CAUTION

DO NOT clamp center section of trim cylinder during reassembly. If clamping of cylinder is necessary, clamp cylinder on front mounting flange.

⚠CAUTION

Use only 2-4-C Marine Lubricant on end cap threads. Other substances may act as an insulator and cause poor electrical continuity between cap and cylinder which could cause a corrosion problem.

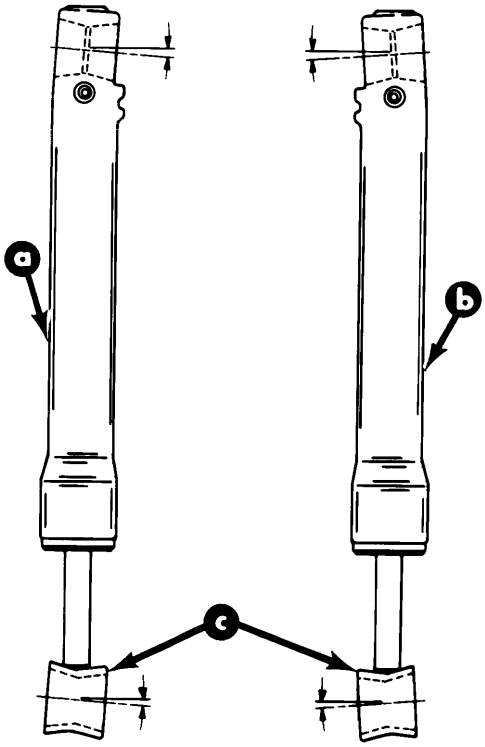
11. Apply 2-4-C Marine Lubricant to end cap threads and install piston rod assembly into cylinder. Tighten end cap securely using a spanner wrench.



22133

a - End Cap
a - Piston Rod Assembly
b - Cylinder

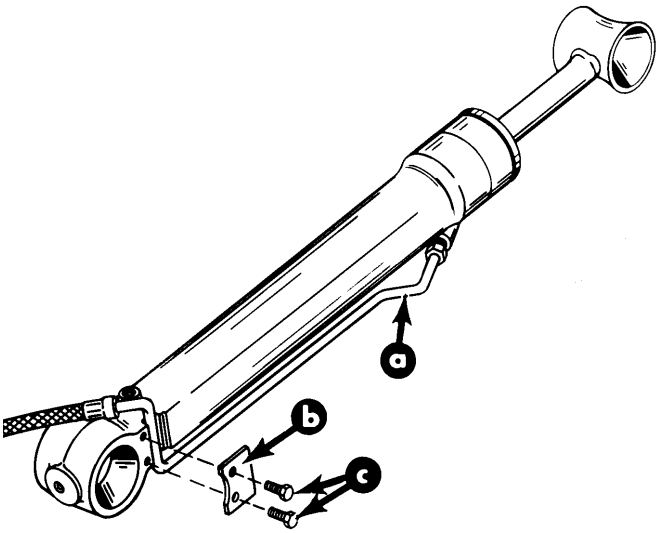
12. Position trim cylinder rear connecting ends as shown.



22135

a - Port Trim Cylinder
b - Starboard Trim Cylinder
c - Connecting Ends (Angled As Shown)

13. Install DOWN trim hose.



22130

a - DOWN Trim Hose
b - Clamping Plate
c - Screws

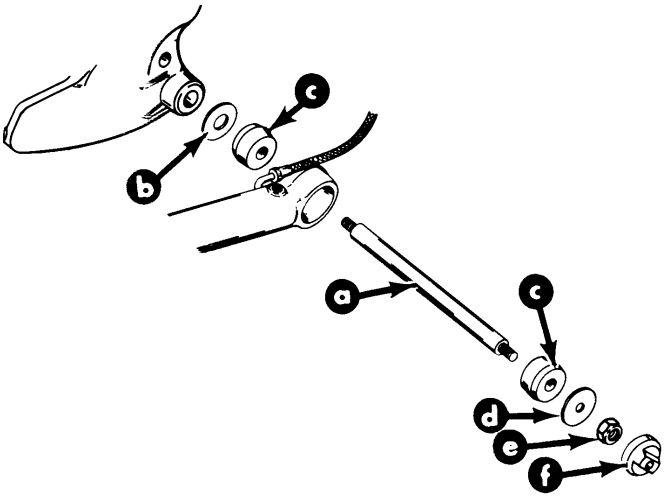
14. Check painted areas of trim cylinders for scratches that expose metal, paint if necessary.

Installation

⚠CAUTION

Use water and soap solution to aid in installing rubber bushings. The use of petroleum based product (oil and grease) can deteriorate rubber.

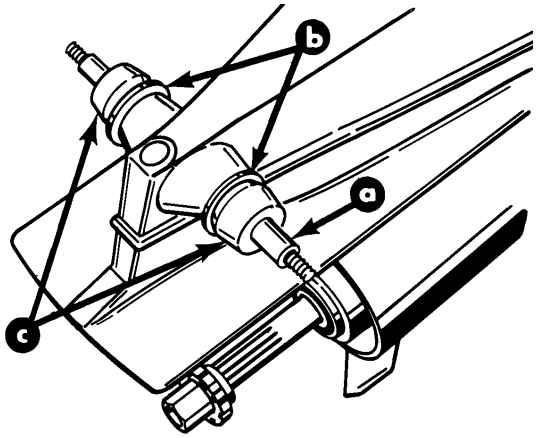
1. Install trim cylinder forward mounting hardware as shown.
2. Coat anchor pin threads with 2-4-C Marine Lubricant (to prevent threads from galling).
3. Hand thread locknuts onto pin. DO NOT tighten at this time.



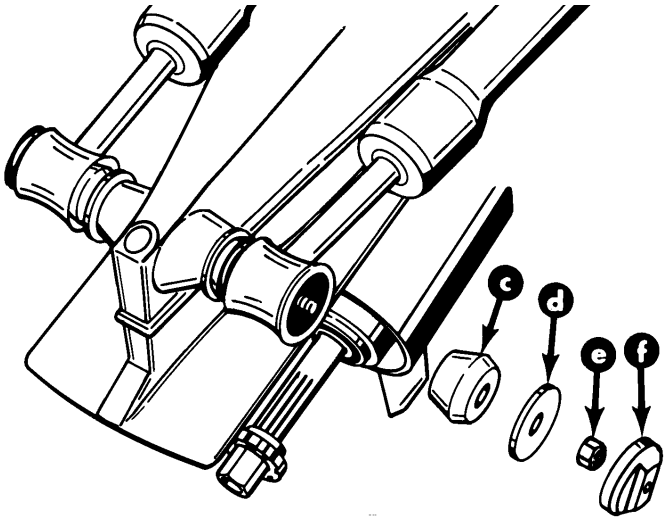
22133

a - Forward Anchor Pin (Longer)
b - Washers (2) - Large I.D.
c - Rubber Bushings (4)
d - Washers (2) - Small I.D.
e - Locknuts (2)
f - Plastic Caps (Installed After Final Tightening of Nuts)

4. Install trim cylinder aft mounting hardware as shown.
5. Coat anchor pin threads with 2-4-C Marine Lubricant (to prevent threads from galling).
6. Hand thread locknuts onto anchor pin.



22060



22441

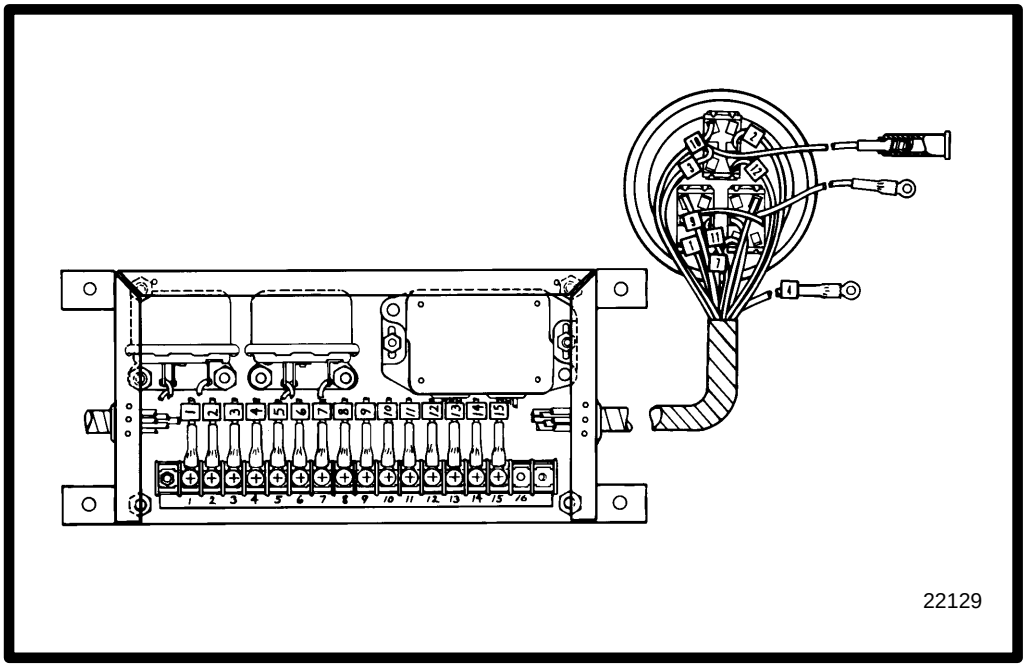
a - Aft Anchor Pin (Shorter)
b - Washers (2) - Large I.D.
c - Rubber Bushings
d - Washers (2) - Small I.D.
e - Locknuts (2)
f - Plastic Caps (2) - (Install After Final Tightening)

⚠CAUTION

All 4 anchor pin locknuts must be tightened as described following or damage to sterndrive unit may result from drive unit moving too far inward.

7. Tighten 4 anchor pin locknuts until nuts and washers bottom out against anchor pin shoulder.
8. Reconnect trim hoses after air bleeding power trim cylinders and hoses following procedures outlined in Section 5A, 5B, or 5C (See Table of Contents).

POWER TRIM



5

E

DUAL POWER TRIM CONTROL

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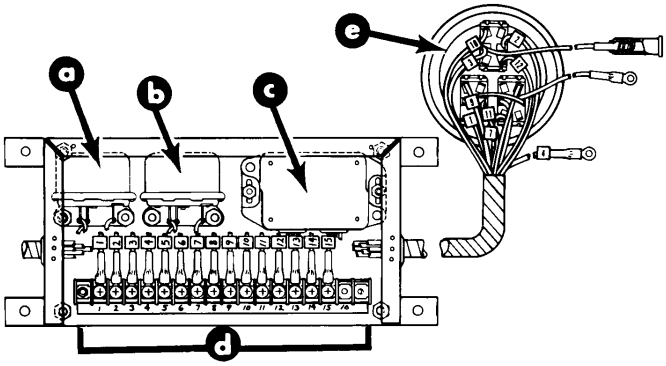
Important information

When testing this Dual Power Trim system, take special note of the following:

1. Control box harness connectors must be disconnected and key switch must be “OFF.”
2. Make certain that the jumper lead used between terminal 3 and 5 is used only when specified.

The tests, listed following, are in a sequence according to probability of component failure. It is recommended, however, that all tests be performed even if a faulty component is detected early in the sequence. This precaution will guard against repeat failure if there is more than one failed component.

Testing Dual Power Trim System



22129

Dual Trim Control Panel Wiring Diagram

a - Relay No. 1
b - Relay No. 2
c - Diode Module
d - Terminal Block
e - Control Panel

Relay Test

1. **Testing Relay No. 1**
   a. Test for 12 volts at terminal 2**,** using only terminal 4 as a ground.
      - **Voltage Indicated:** proceed to “b.”
      - **No Voltage Indicated:** replace relay.
   b. Connect a jumper wire between terminals 3 and 5. Test for 12 volts at terminal 2, using only terminal 4 as a ground.
      - **No Voltage Indicated:** relay ok.
      - **Voltage Indicated:** replace relay.
2. **Testing Relay No. 2**
   a. Test for continuity between terminals 13 and 9.
      - **Continuity Indicated:** proceed to “b.”
      - **No Continuity Indicated:** replace relay.
   b. Connect a jumper wire between terminals 3 and 5. Test for continuity between terminals 13 and 9.
      - **No Continuity Indicated:** relay ok.
      - **Continuity Indicated:** replace relay.

Diode Module Test

Perform the following diode tests using an ohmmeter set on Rx1 scale. When testing diodes, take 2 readings. Note first reading; then, reverse meter leads again noting reading.

If diode is good, meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading (below 60 ohms) when connected the other way.

If both readings are high or infinite, diode is open. Replace diode module.

If both readings are low, diode is shorted. Replace diode module.

Diode No. 1

Connect a jumper wire between terminals 3 and 5. Test diode between terminals 9 and 10.

Diode No. 2

Connect a jumper between terminals 3 and 5. Test diode between terminals 10 and 13.

⚠CAUTION

Before proceeding with further diode testing, remove fuse from red/purple harness lead so that it will not be possible to short either control box or VOA meter.

Diode No. 3
Test diode between terminals 6 and 12.
Diode No. 4
Test diode between terminals 12 and 7.
Diode No. 5
Test diode between terminals 8 and 11.
Diode No. 6
Test diode between terminals 14 and 15.
Diode No. 7
Test diode between terminals 8 and 5.
Diode No. 8
Test diode between terminals 5 and 15.

Trailer Switch Test

⚠ CAUTION

Remove fuse from red/purple harness lead before proceeding with test.

1. Set ohmmeter on Rx1 scale.
2. Push down on “TRAILER” switch and check for continuity between terminals 10 and 3.
   - **Continuity Indicated:** proceed to step 3.
   - **No Continuity Indicated:** replace switch.
3. Push up on “TRAILER” switch and check for continuity between terminals 2 and 12.
   - **Continuity Indicated:** switch ok.
   - **No Continuity Indicated:** replace switch.

Starboard Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on “STBD TRIM” switch and check for continuity between terminals 1 and 9.
   - **Continuity Indicated:** proceed to step 3.
   - **No Continuity Indicated:** replace switch.
3. Push up on “STBD TRIM” switch and check for continuity between terminals 11 and 6.
   - **Continuity Indicated:** switch ok.
   - **No Continuity Indicated:** replace switch.

Port Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on “PORT TRIM” switch and check for continuity between terminals 2 and 13.
   - **Continuity Indicated:** proceed to step 3.
   - **No Continuity Indicated:** replace switch.
3. Push up on “PORT TRIM” switch and check for continuity between terminals 14 and 7.
   - **Continuity Indicated:** switch ok.
   - **No Continuity Indicated:** replace switch.

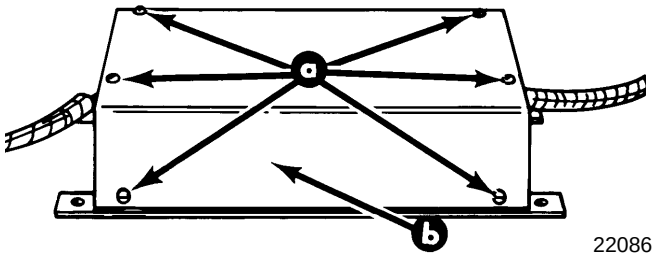
Dual Power Trim System Component Repair

Important Information

Use care when removing and installing components. Do not force or pull wiring during replacement. Use care to prevent wiring from stretching, pinching or chafing. Coat all terminal connections with Liquid Neoprene.

Relay Replacement

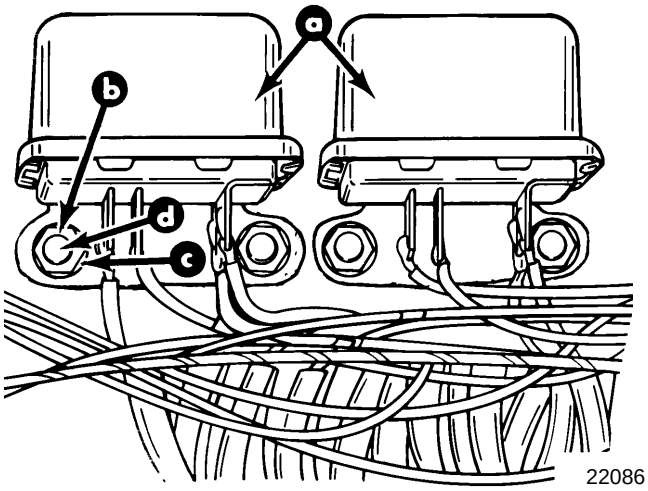
1. Remove control box cover.



22086

a - Screws
b - Cover

2. Unsolder wires from relay to be replaced.
3. Remove relay.



22086

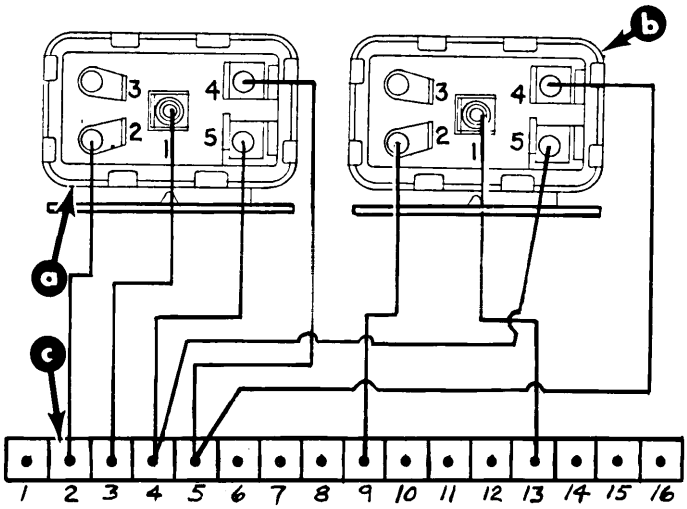
a - Relay Assemblies (1 And 2)
b - Nuts
c - Washers
d - Screws

4. Install new relay.

IMPORTANT: Use 63/67 (Tin/Lead) alloy solder. DO NOT use acid core solder as damage to relay can result. Coat terminal connections with Quicksilver Liquid Neoprene (92-25711).

5. Resolder wires from terminal block to relay as shown.

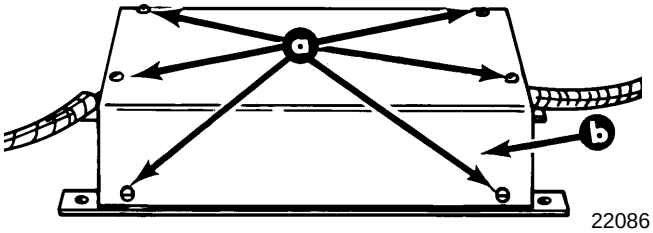
6. Coat terminal connections with Quicksilver Liquid Neoprene (92-25711).



22216

a - Relay No. 1
b - Relay No. 2
c - Terminal Block

7. Install control box cover.

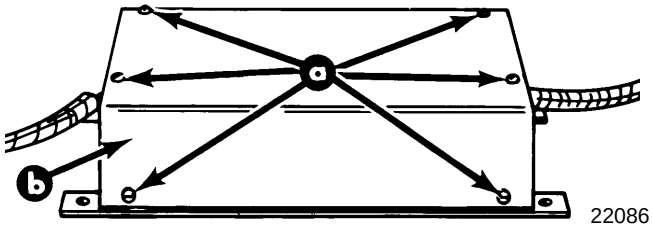


22086

a - Screws
b - Cover

Diode Module Replacement

1. Remove control box cover.

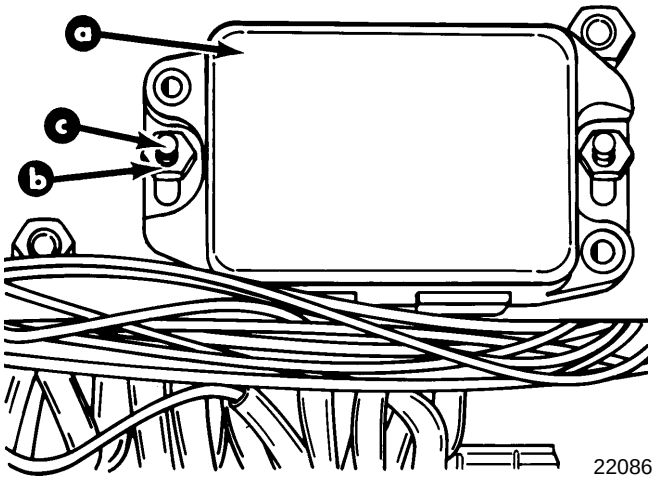


22086

a - Screws
b - Cover

2. Disconnect leads from terminal block.

3. Replace diode module.

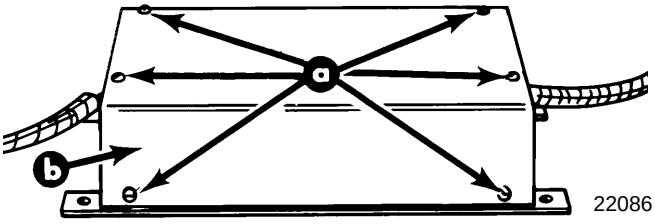


22086

a - Diode Module
b - Nuts
c - Screws

4. Reconnect numbered leads to respective terminals.

5. Install control box cover.

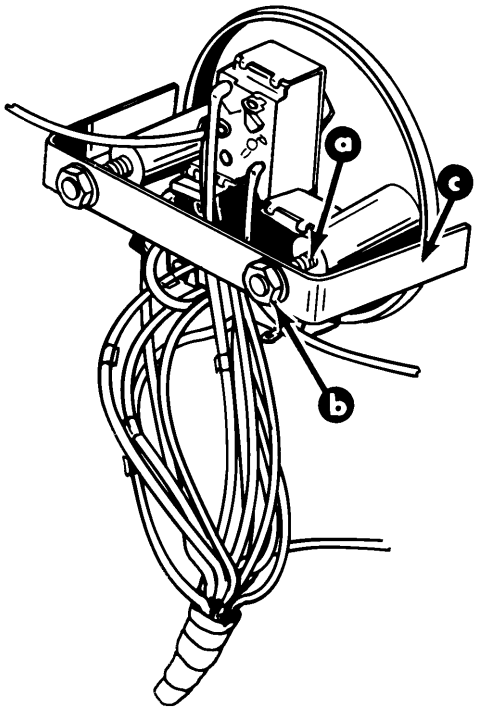


22086

a - Screws
b - Cover

Trim Control Panel Switch(es) Replacement

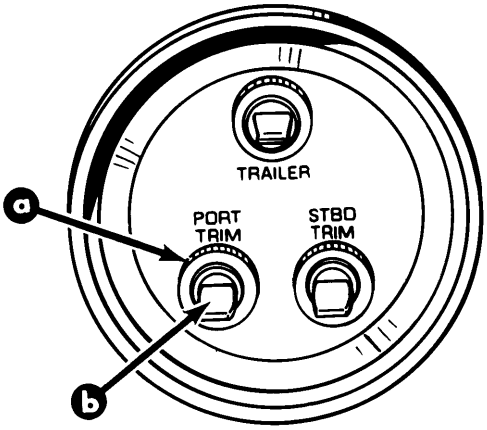
1. Remove trim control panel from dash.
2. Cut leads (from switch to be replaced) as close to switch terminals as possible.



22086

a - No. 10-24 Studs
b - Flat Washers And Nuts
c - U-Bracket

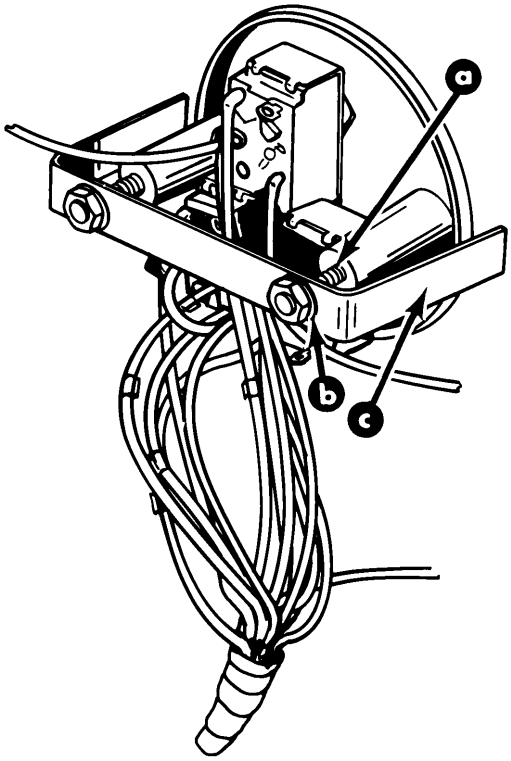
3. Remove bezel nut and replace switch.



22086

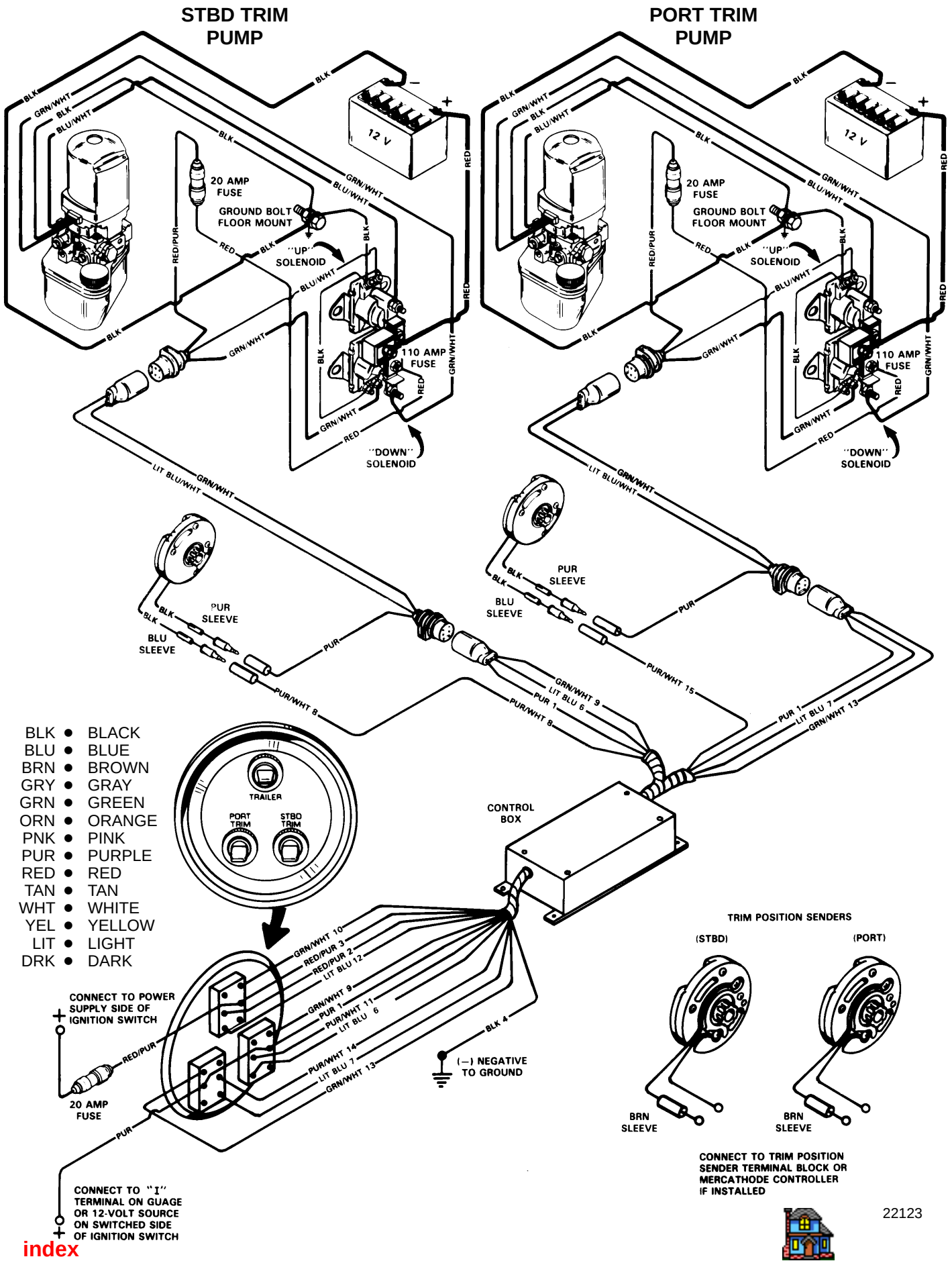
a - Bezel Nut (1 Per Switch)
b - Switch (1 Per Switch)

4. With new switch properly positioned in control panel, loop leads through their respective terminal eyelets. (Refer to Wiring Diagram)
5. Using 60-40 tin-lead alloy rosin core solder, solder leads to terminals.
6. Secure trim control panel to dash.



22086

a - No. 10-24 Studs
b - Flat Washers And Nuts
c - U-Bracket


STBD TRIM PUMP
PORT TRIM PUMP
12 V
20 AMP FUSE
GROUND BOLT FLOOR MOUNT
"UP" SOLENOID
"DOWN" SOLENOID
110 AMP FUSE
BLK
GRN/WHT
BLU/WHT
RED/PUR
RED
LIT BLU/WHT
PUR SLEEVE
BLU SLEEVE
PUR
PUR/WHT 8
PUR/WHT 15
GRN/WHT 9
LIT BLU 6
PUR 1
LIT BLU 7
GRN/WHT 13
BLK ● BLACK
BLU ● BLUE
BRN ● BROWN
GRY ● GRAY
GRN ● GREEN
ORN ● ORANGE
PNK ● PINK
PUR ● PURPLE
RED ● RED
TAN ● TAN
WHT ● WHITE
YEL ● YELLOW
LIT ● LIGHT
DRK ● DARK
TRAILER
PORT TRIM
STBD TRIM
CONTROL BOX
GRN/WHT 10
RED/PUR 3
RED/PUR 2
LIT BLU 12
GRN/WHT 9
PUR 1
PUR/WHT 11
LIT BLU 6
PUR/WHT 14
LIT BLU 7
GRN/WHT 13
BLK 4
CONNECT TO POWER SUPPLY SIDE OF IGNITION SWITCH
20 AMP FUSE
(–) NEGATIVE TO GROUND
CONNECT TO "I" TERMINAL ON GUAGE OR 12-VOLT SOURCE ON SWITCHED SIDE OF IGNITION SWITCH
TRIM POSITION SENDERS
(STBD)
(PORT)
BRN SLEEVE
CONNECT TO TRIM POSITION SENDER TERMINAL BLOCK OR MERCATHODE CONTROLLER IF INSTALLED

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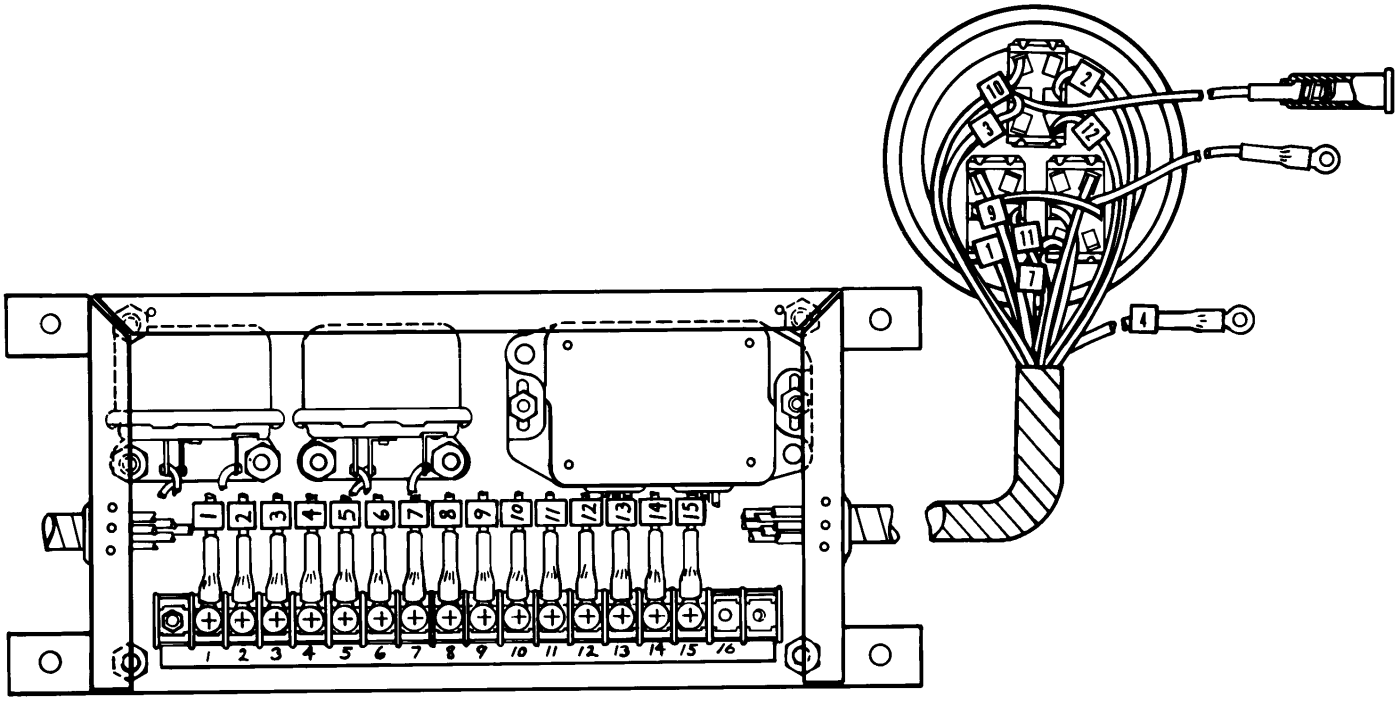
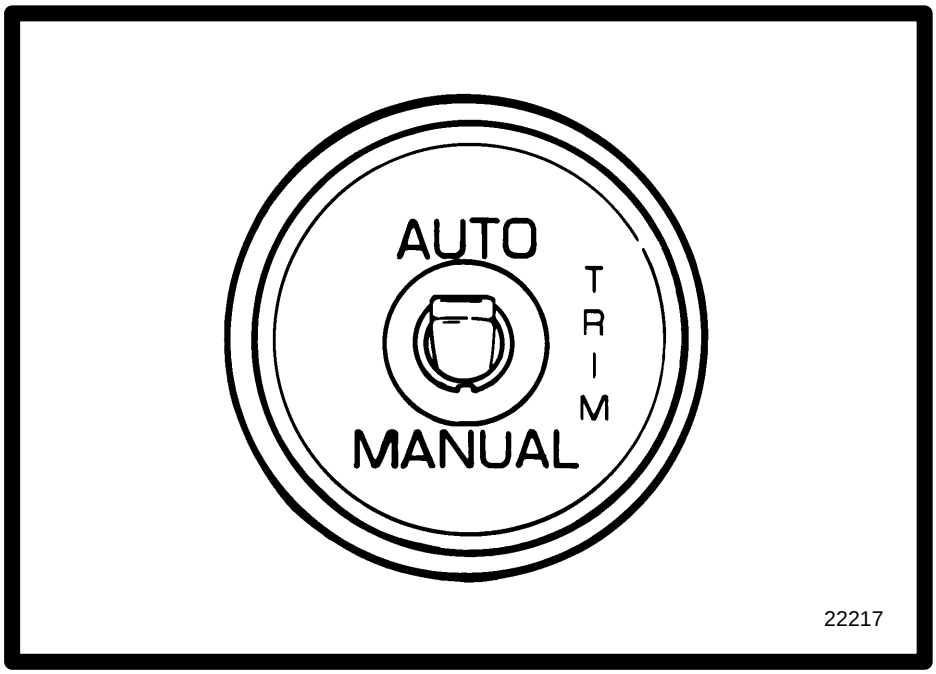


CONTROL BOX WIRING 22129

POWER TRIM



5

F

AUTO TRIM AND AUTO TRIM II

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Trim Position Indicator Adjustment	5F-6

Auto Trim System

Description

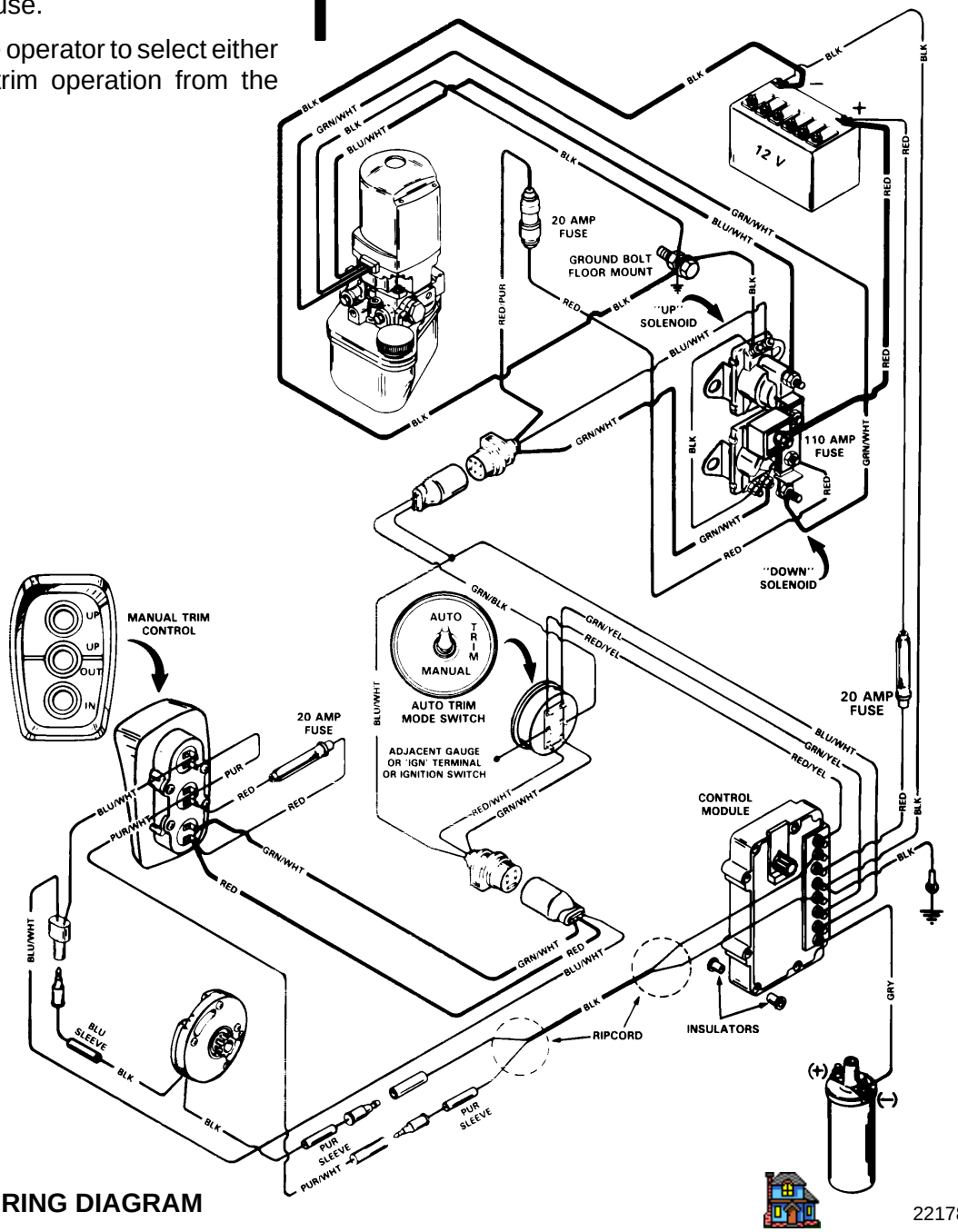
NOTE: *The only difference between AUTO TRIM and AUTO TRIM II, is that AUTO TRIM II has an Adjustment Knob on the Control Module.*

The Auto Trim System consists of the following major components:

- Auto Trim Pump – same pump that is used on the standard Power Trim models.
- Control Module – a solid-state electronic device that senses engine RPM and regulates the time at which the drive unit trims “In” and “Out” when operating in the “AUTO” mode. Module is protected by a 20-amp fuse.
- Mode Switch – allows the operator to select either “AUTO” or “MANUAL” trim operation from the dash.
- Manual Trim Control – will only function with mode switch in the “MANUAL” mode and ignition switch in the “RUN” position. Allows the operator to raise and lower the drive unit for trailering, beaching, launching and shallow water operation. Also, allows the operator to manually adjust the drive unit trim angle while underway in situations where automatic trimming is not desired (rough seas, etc.).
- Trim Limit Switch – Establishes the maximum trim “Out” limit in both the “MANUAL” and “AUTO” mode. Prevents drive unit from moving out of the gimbal ring support flanges, which could cause possible damage to stern drive if it were to occur at higher engine speeds.

POWER TRIM

BLK	●	Black
BLU	●	Blue
BRN	●	Brown
GRY	●	Gray
GRN	●	Green
ORN	●	Orange
PNK	●	Pink
PUR	●	Purple
RED	●	Red
TAN	●	Tan
WHT	●	White
YEL	●	Yellow
LIT	●	Light
DRK	●	Dark

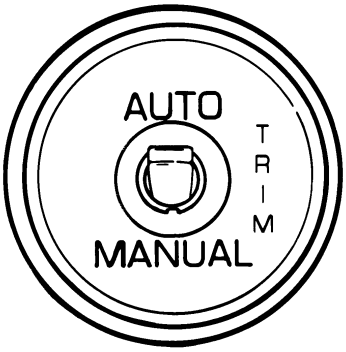


AUTO TRIM II SYSTEM WIRING DIAGRAM

22178

Auto Trim Operation

The Auto Trim system is designed to allow either automatic or manual trimming of the boat while underway – in addition to allowing drive unit to be raised for trailering, beaching, launching or shallow water operation. A 2-position switch on dashboard allows the operator to select the mode desired.



22217

Auto Trim Mode Switch

"AUTO" MODE OPERATION

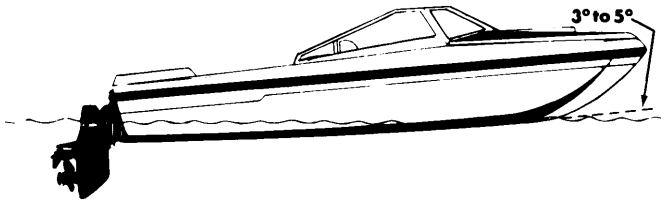
⚠ WARNING

Drive unit will automatically lower from the raised position when the ignition switch is turned to the "RUN" position and mode switch is placed in the "AUTO" mode. BE SURE THAT NO ONE IS IN THE AREA OF THE DRIVE UNIT.

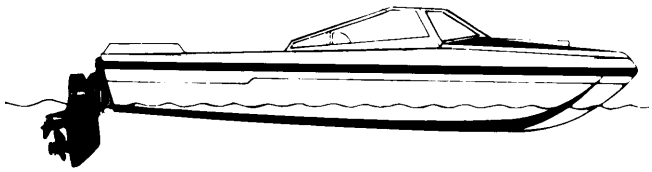
With mode switch in the "AUTO" mode, the drive unit will move automatically to properly trim boat while underway. This allows boat operator to keep both hands on the steering wheel and to direct operator's full attention to drive the boat.

- **At engine speeds below 3100 RPM,** the drive unit will remain in the full "In" position. This will force the bow of the boat down and help it get up on plane quickly.
- **Once engine reaches 3100 RPM and after a 5-6 second delay (to ensure that boat is up on plane),** the drive unit will automatically trim "Out" to a preset position for maximum boat speed and efficiency. Trim "Out" position can be adjusted to fine tune the trim angle for each individual boat.
- **Upon deceleration,** the drive unit will trim "In" when engine reaches 2600 RPM. Most boats will still be up on plane at this point. After drive reaches full "In" position, the trim pump motor will continue to run for approximately 5 seconds.

NOTE: *The "AUTO" mode also can be used to lower the drive unit from the fully raised (trailering) position. By placing ignition switch in "RUN" position and mode switch in "AUTO" mode, the drive unit will automatically lower to the full "In" position. Be sure that no one is in the area of the drive unit.*



Boat Running Above Planing Speed



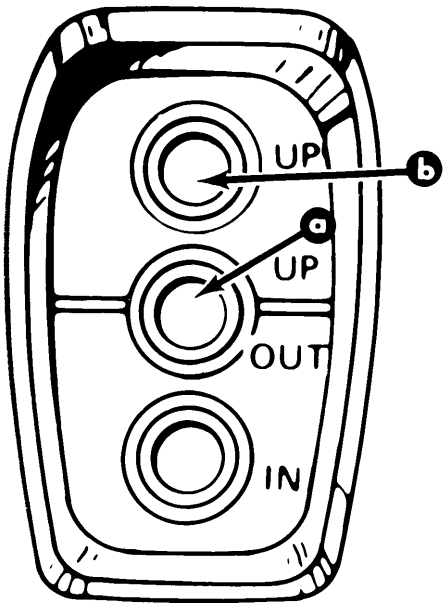
Boat Running Below Planing Speed

"MANUAL" MODE OPERATION

Placing the mode switch in the "MANUAL" position will deactivate the "AUTO" system and allow the operator to adjust drive unit position, using the manual trim control. Typical controls are shown following. Manual trimming may be desirable to fine tune the trim angle for a particular water condition or boat load, or in situations where greater control over the trim operation is needed.

Manual trim control also must be used to raise the drive unit for trailering, beaching, launching and shallow water operation. Ignition switch must be in the "RUN" position for manual trim control to function.

1. RAISING DRIVE UNIT.

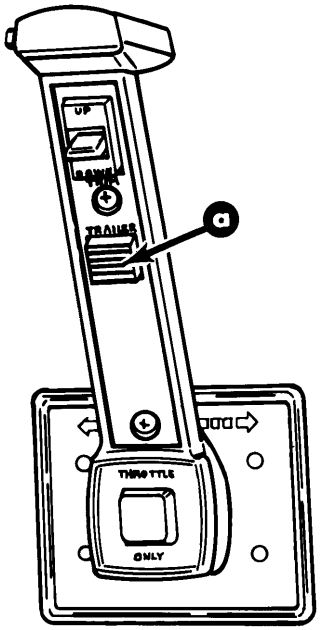


22174

a - "Up"/"Out" Button
b - "Up" Button

Press Until Drive Unit Reaches Desired Height or End of Upward Travel

Quicksilver 3-Button Trim Control Panel



22212

Quicksilver "Commander" Panel Trim Control

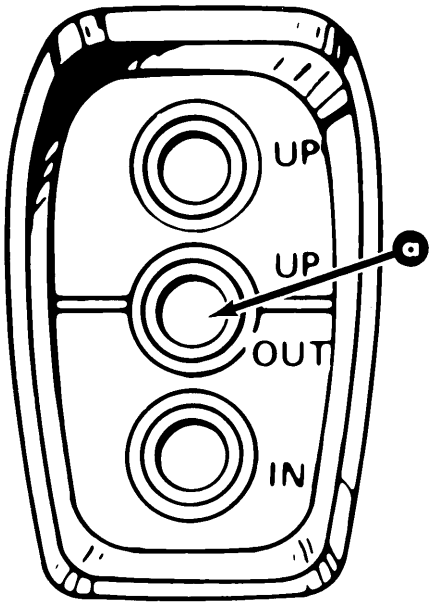
a - "Trailer" Switch – Press Until Drive Unit Reaches Desired Height or End of Upward Travel

NOTE: *Some Power Trim pump motors are protected from overheating by an internal circuit breaker. If trailering switch(es) are held depressed after drive unit reaches end of upward travel, internal circuit breaker will open and pump will stop. If this should happen, release switch(es) and allow motor to cool for approximately 2 minutes. Once motor is cool, circuit breaker will reset automatically, and trim operation may be resumed.*

⚠ CAUTION

DO NOT run engine above idle RPM with unit raised for shallow water operation, as drive unit is out beyond gimbal ring support flanges and has no side support. USE EXTREME CAUTION WHEN OPERATING BOAT WITH DRIVE UNIT RAISED.

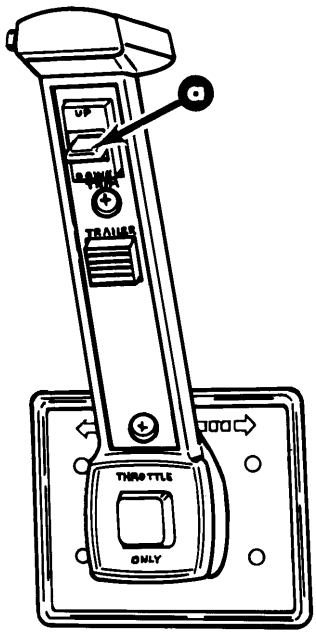
2. TRIMMING DRIVE UNIT "OUT" (BOW "UP"). Press switch until drive unit moves to properly trim boat or trim limit switch stops outward travel.



22174

Quicksilver 3-Button Trim Control Panel

a - "Up"/"0ut" Button – Press



22212

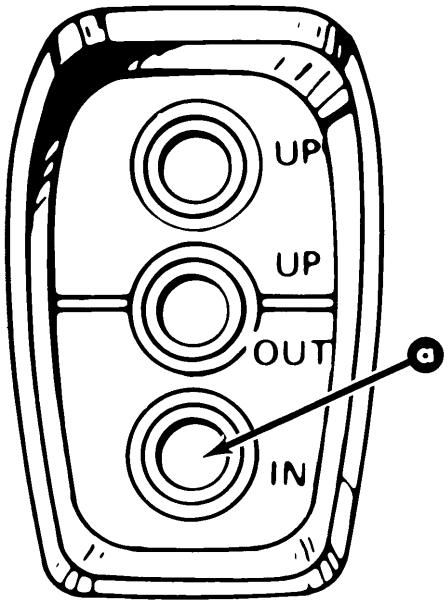
Quicksilver "Commander" Panel Trim Control

a - "Trim" Switch – Press Up on Switch

⚠ CAUTION

NEVER trim the drive unit "Out" using the "Trailer" switch(es) while boat is underway. Severe damage to drive unit may result if the unit is raised beyond the gimbal ring support flanges at engine speeds above idle RPM.

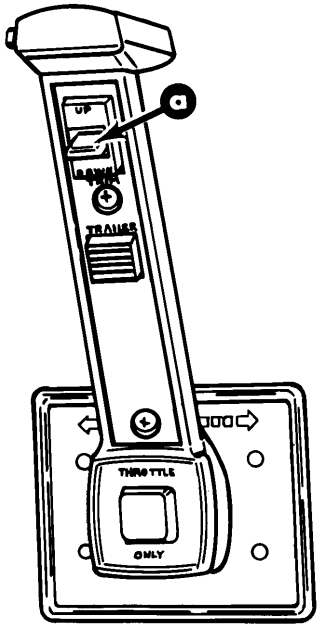
3. TRIMMING DRIVE UNIT "IN" (BOW "DOWN") – Press switch until drive unit moves to properly trim boat or until drive unit reaches end of downward travel.



22174

Quicksilver 3-Button Trim Control Panel

a - "In" Button – Press



22212

Quicksilver "Commander" Panel Trim Control

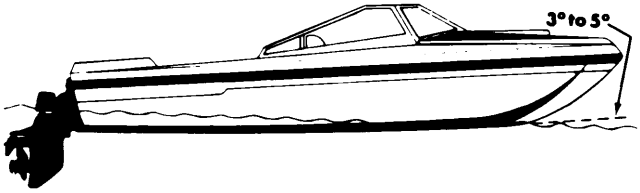
a - "Trim" Switch – Press Down on Switch

Electrical System Overload Protection

The Auto Trim electrical system is protected from overload by a 110-amp fuse, and a 20-amp in-line fuse at control module positive (+) battery lead and a 20-amp in-line fuse at ignition switch (if Quicksilver ignition switch is used). If boat is equipped with 3-Button Control Panel, a 20-amp in-line fuse also is located at panel. If Auto Trim electrical system becomes inoperative, check for a blown fuse. If fuse has blown, the cause for overload MUST BE found and corrected BEFORE replacing fuse.

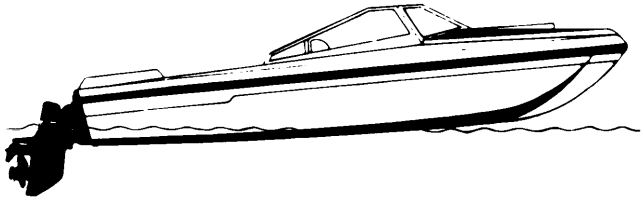
Auto Trim Limit Adjustment

In most cases, best all-around performance is obtained with drive unit adjusted so that front of hull will be slightly out of water when boat is on plane.



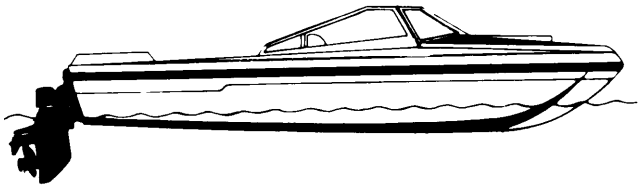
Boat Properly Trimmed

Adjusting the drive unit "Out" from this position will tend to raise the bow of the boat, thus further reducing the wetted surface of the hull and, in some cases, increasing boat speed. However, if trimmed out excessively, bouncing, porpoising, propeller ventilation and possible difficult steering control could result.



Bow Too High – Move Drive Unit "In"

Adjusting the drive unit “In” from normal position will force the bow of the boat down, thus increasing the wetted surface of the hull and, in some cases, improving boat ride in rough water (at partial throttle). However, this will reduce boat speed in most cases.



Bow Too Low – Move Drive Unit “Out”

ADJUSTING DRIVE UNIT TRIM ANGLE

⚠ WARNING

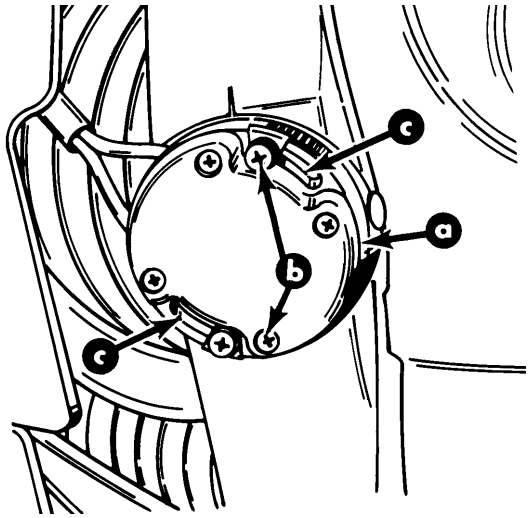
When adjusting trim limit, following, use extreme care that engine is not accidentally started and keep clear of area near propeller. Also, use care to prevent placing hands in an area where they could be injured by drive unit movement.

⚠ CAUTION

Trim limit switch MUST BE adjusted exactly as stated following. If switch is adjusted incorrectly, drive unit may move out beyond the gimbal ring support flanges (when making test run following), and severe damage to stern drive unit may result.

If more trim “Out” capability is desired, perform the following.

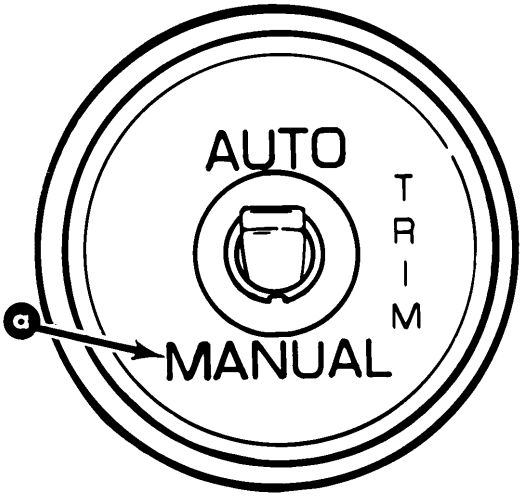
1. Place drive unit in the full “In”/“Down” position.
2. Turn trim limit switch clockwise to end of slots.



22091

a - Trim Limit Switch
b - Retaining Screws – Loosen
c - Adjusting Slots

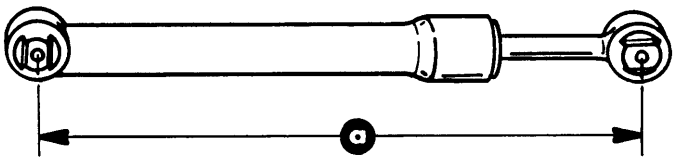
3. Place Auto Trim mode switch in the “MANUAL” mode; turn ignition key to the “RUN” position.



22217

a - Mode Switch – Place in “MANUAL” Mode

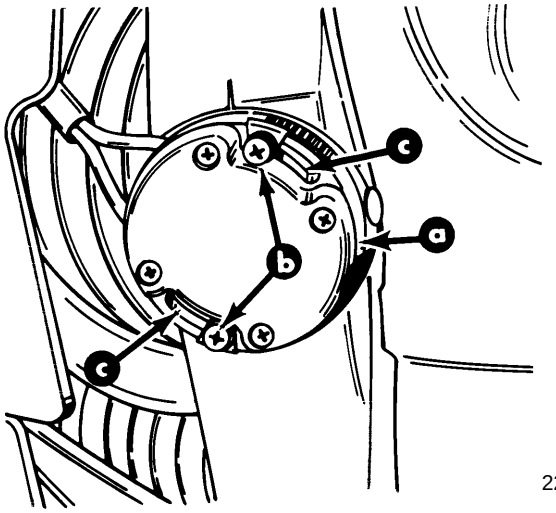
4. With the assistance of another person actuate manual trim control switch used to trim drive unit “Out” (DO NOT use “Trailer” switch) and turn trim limit switch SLOWLY counterclockwise until trim cylinders extend to dimension shown. Retighten trim limit switch retaining screws.



50464

a - 21-3/4 in. ± 1/4 in. (554mm ± 6mm)

5. Turn ignition key “OFF”.
6. Run boat along a relatively smooth stretch of water and trim boat with manual trim control until optimum boat performance is achieved.
7. After finding trim angle that provides best performance, stop engine (without changing drive unit trim angle). Accurately measure distance between trim cylinder end cap and pivot end.
8. Place drive unit in the full “In” position. Loosen trim limit switch retaining screws and turn switch clock-wise to end of slots.



22091

a - Trim Limit Switch
b - Trim Limit Switch Retaining Screws
c - Adjusting Slots

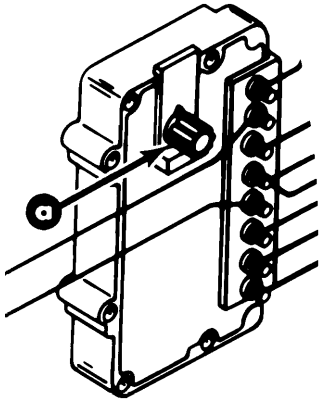
9. Leaving Auto trim mode switch in the “MANUAL” mode, turn ignition key to “RUN” position. With the assistance of another person, actuate manual trim control switch used to trim drive unit “Out” and turn trim limit switch slowly counterclockwise until trim cylinders extend to dimension recorded in STEP 7. Tighten switch retaining screws securely.
10. Run boat with Auto Trim mode switch in “AUTO” position at several speeds, through turns under various water and load conditions, If boat does not perform to satisfaction, repeat adjusting procedure.

⚠ WARNING

Difficulties in handling and operational control may result if drive unit is adjusted “Out” too far. If difficulties are encountered, drive unit trim angle MUST BE moved “In” the amount necessary to eliminate the problem and avoid a possible safety hazard.

Control Module Adjustment (Auto Trim II Only)

1. Turn adjustment knob on control module full counterclockwise.
2. Rotate knob clockwise four clicks (notches).
3. With mode switch in “AUTO” position and the drive unit trimmed full “in”, accelerate boat slowly while watching trim gauge.
4. If boat is on plane well before drive unit begins to trim out (this may happen with lighter, faster boats), rotate adjustment knob counterclockwise one click and accelerate boat slowly. Continue procedure until boat is on plane approximately five or six seconds before trim out occurs.
5. If boat is not on plane before drive unit begins to trim out (this may happen with slower, heavier boats), rotate adjustment knob clockwise one click and accelerate boat slowly.

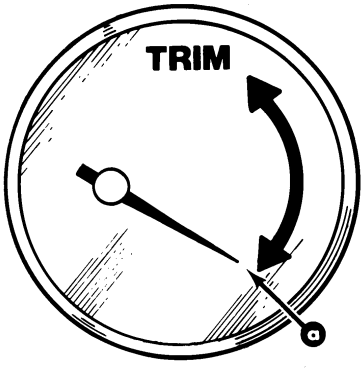


22178

a - Adjustment Knob

Trim Position Indicator Adjustment

With ignition key in the “RUN” position, check Auto Trim indicator to make sure that needle points to bottom of the scale when drive unit is fully “IN”. If needle is not at bottom of scale, perform steps following.



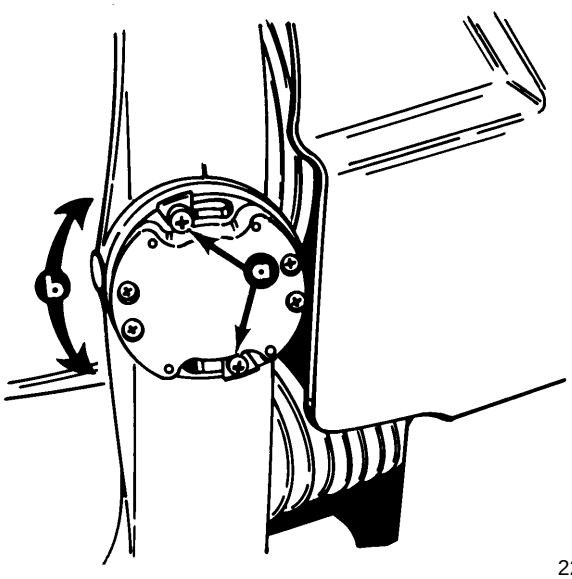
22175

a - Needle at Bottom of Scale – Drive Unit in F[illegible]n” Position

⚠ CAUTION

While performing this adjustment, use extreme care that engine is not accidentally started and keep clear area near propeller.

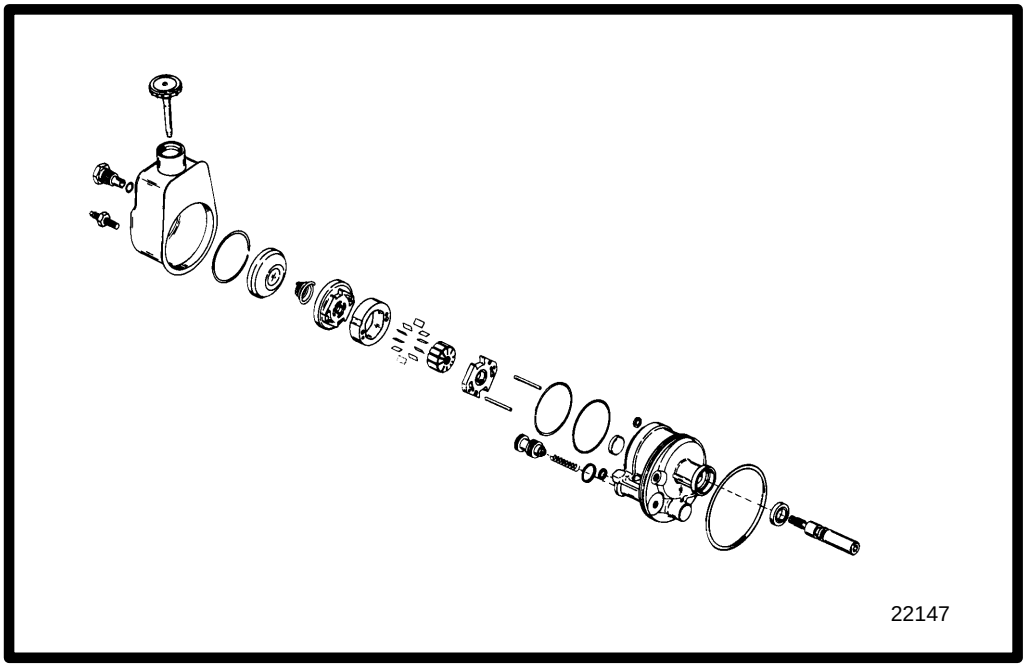
1. Turn ignition key to “RUN” position.
2. Loosen trim position sender retaining screws.
3. Rotate sender, as required, to position indicator at bottom of scale.
4. Tighten retaining screws securely.
5. Recheck instrument reading and turn ignition key to “OFF” position.



22091

a - Retaining Screws
b - Turn to Adjust

STEERING SYSTEM



6
A

POWER STEERING

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Specifications

Torque Specification

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Coupler Nut		35	48
Pivot Bolts		25	35
Power Steering Hose (Large Fitting)		20-25	27-34
Power Steering Hose (Small Fitting)	96-108		11-12
Steering Tube Nut		15-20	20-27
Control Valve Screw		25-35	34-47
Power Steering Fitting Assembly		35	47

Special Tools

Description	Part No.
Power Steering Test Gauge	91-38053A3
Power Steering Pump Pulley Installer	91-93656A1

KENT-MOORE SPECIAL TOOLS
Can be ordered from:
Kent-Moore Tools, Inc.
29784 Little Mack
Roseville, MI 48066
Phone: 313-774-9500

Power Steering Pump Pulley Remover	Kent-Moore Part No. J-25034-C

Lubricants/Sealers/ Adhesives

Description	Part No.
2-4-C Marine Lubricant	92-825407A2
Special Lubricant 101	92-13872A1
Locquic Primer T	92-59327-1
Loctite No. 35	92-59328-1
Loctite Type A	Obtain Locally

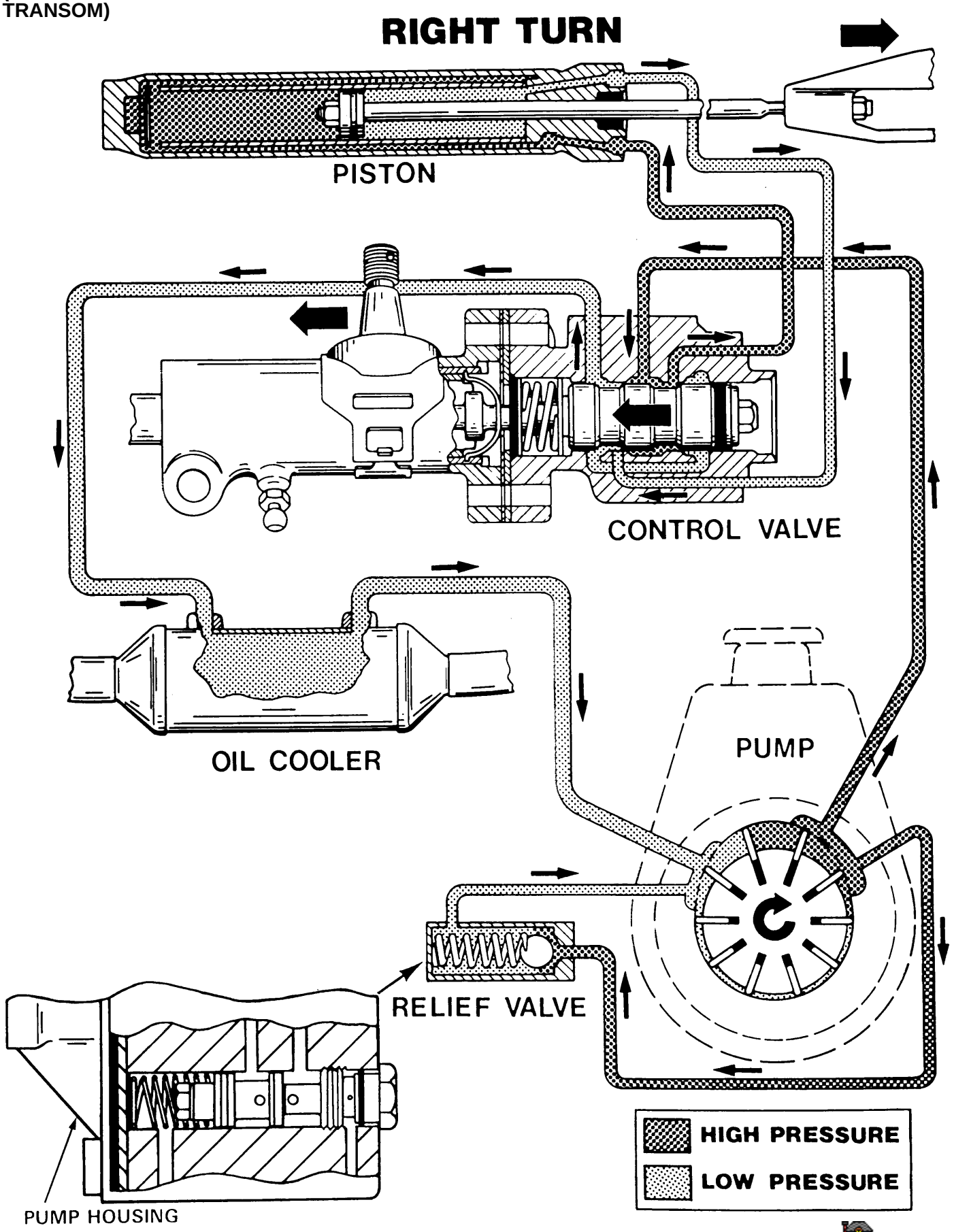
Description

The Power Steering system utilizes an engine-driven, vane-type hydraulic pump that supplies fluid flow and pressure by means of hoses to a control valve that, in turn, controls fluid flow and pressure to-and-from a booster cylinder. Three modes make up the basic function of the Power Steering system: 1) neutral mode, 2) left-turn mode, and 3) right-turn mode. The control valve, which is activated by the steering cable, controls the steering system modes.

NOTE: *The following Power Steering unit installations are viewed from inside boat, looking at transom.*

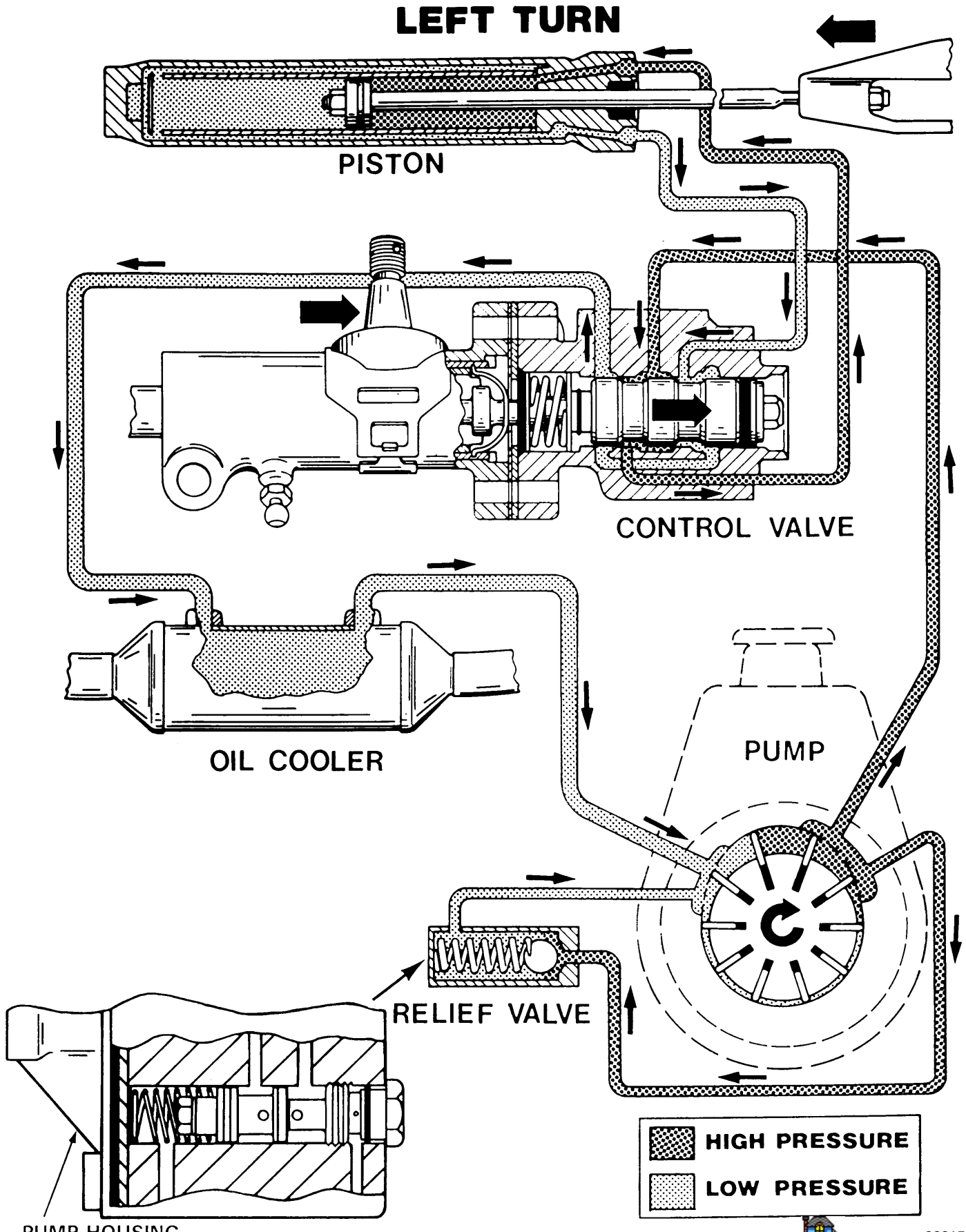
Power Steering System

(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)



Power Steering System

(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)



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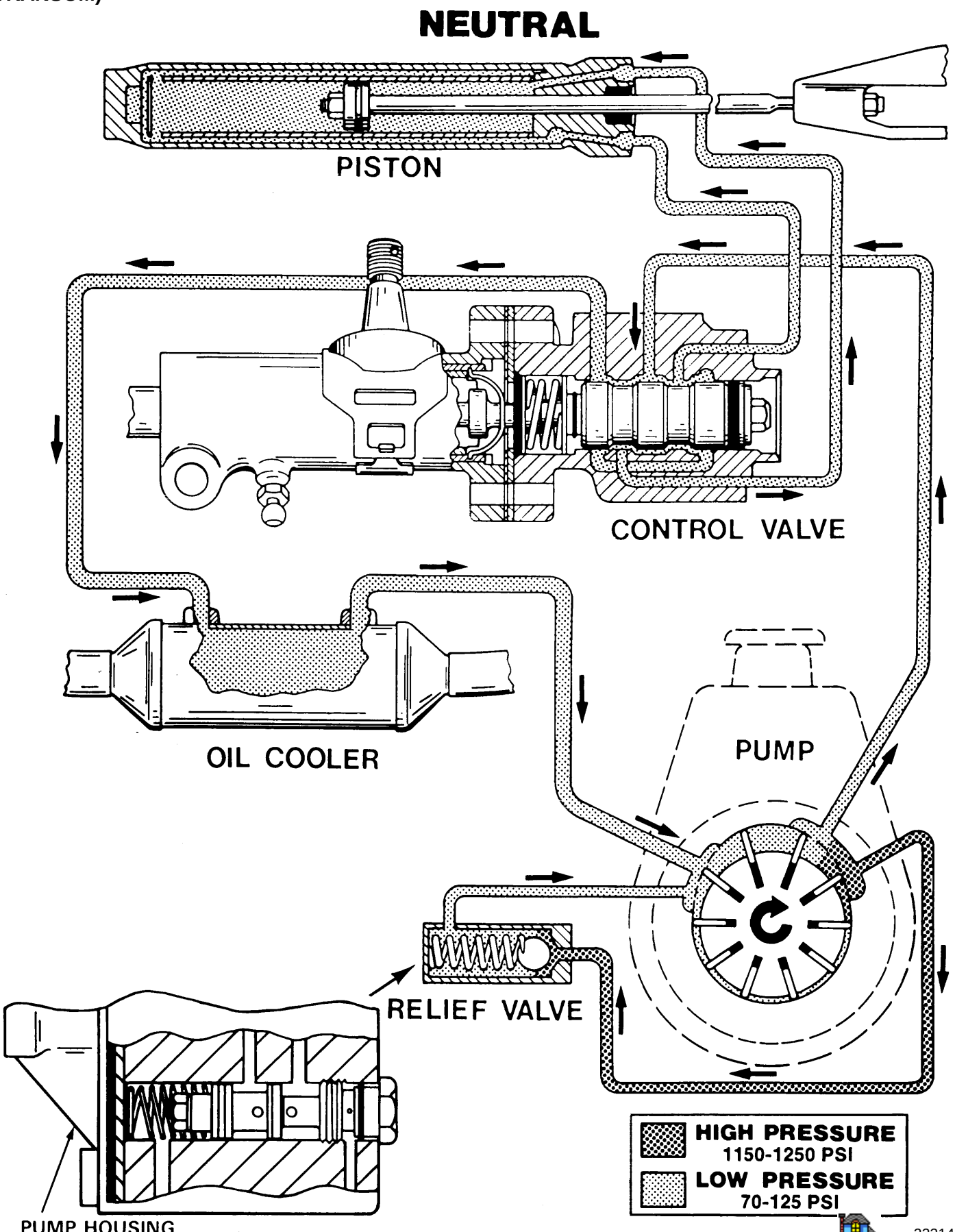
Power Steering System

(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)



22214

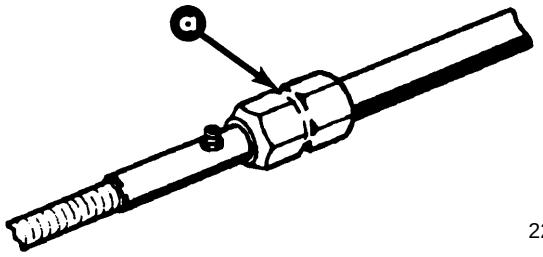
Steering Helm and Cable

Transom assembly is shipped with the steering cable guide tube preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

⚠ WARNING

Failure to use a steering cable locking device could cause loss of steering, which could cause damage to the boat and/or injury.

All current production Quicksilver Ride Guide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)

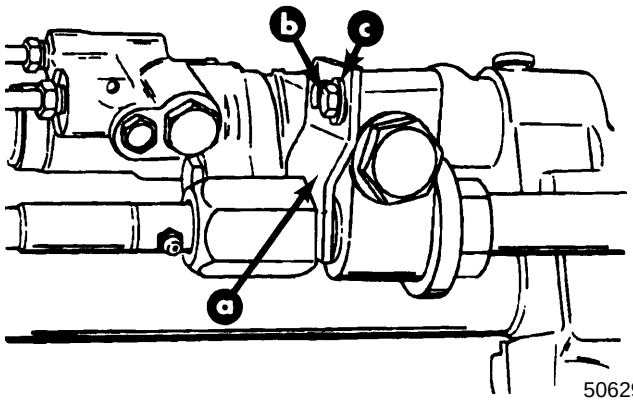


22060

a - Quicksilver Ride Guide Steering Cable Self-Locking Coupler Nut (Identified By Groove)

NOTE: *If using a steering cable that does not have a self- locking coupler nut, an external locking device must be used.*

Power Steering Models



50629

a - Locking Plate 92766
b - Screw 10-41209-(See “Torque Specifications”)
c - Washer 12-35462

⚠ CAUTION

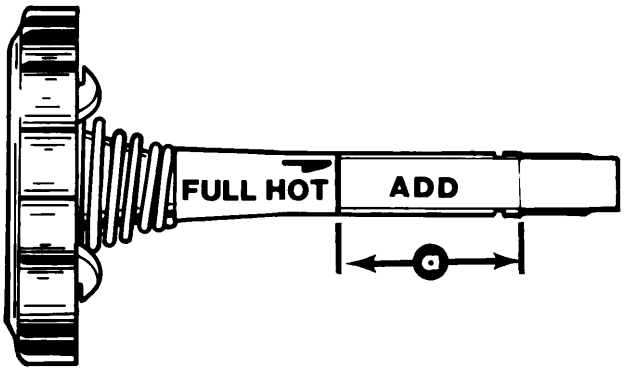
POWER STEERING EQUIPPED UNITS ONLY-If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result. DO NOT attempt to adjust cable guide tube on power steering unit, as guide tube and locknut have been torqued (with Loctite) at the factory, and an attempt to loosen nut or sleeve may result in damage to tube.

1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks or loops in cable.
3. **Power Steering Models:** Fully extended steering cable end dimension must be correct.

Filling and Air Bleeding Power Steering System

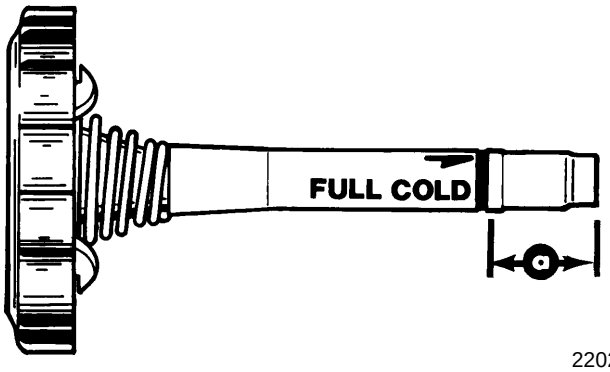
IMPORTANT: Power Steering system MUST BE filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. Position drive unit straight back. Remove fill cap from power steering pump and check fluid level with dipstick.
2. Add Quicksilver Power Trim and Steering Fluid or Dexron II, as required to bring fluid up to correct level.



Engine Warm from Operation

a - Recommended Fluid Level



22023

Engine Cold

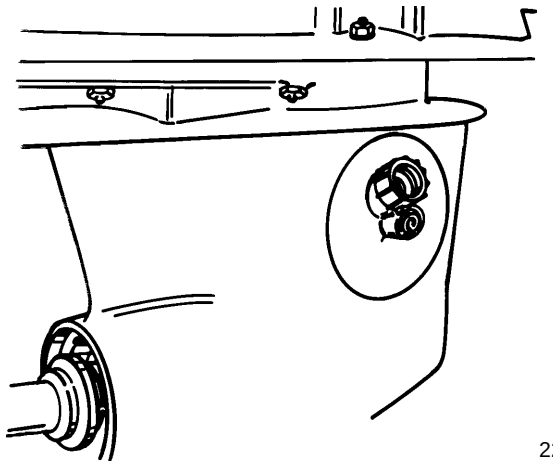
a - Recommended Fluid Level

3. (With engine not running), turn the steering wheel at a moderate rate, back-and-forth, to end of travel in each direction, pausing each time at end of travel for a few seconds to allow any air to bubble from pump reservoir. Do this a minimum of 5 complete cycles. Recheck fluid level and add if necessary.
4. Reinstall fill cap.

⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup holes in gear housing. Overheating damage to engine may result.

5. Install flush test device and connect a hose between it and water tap.



22029

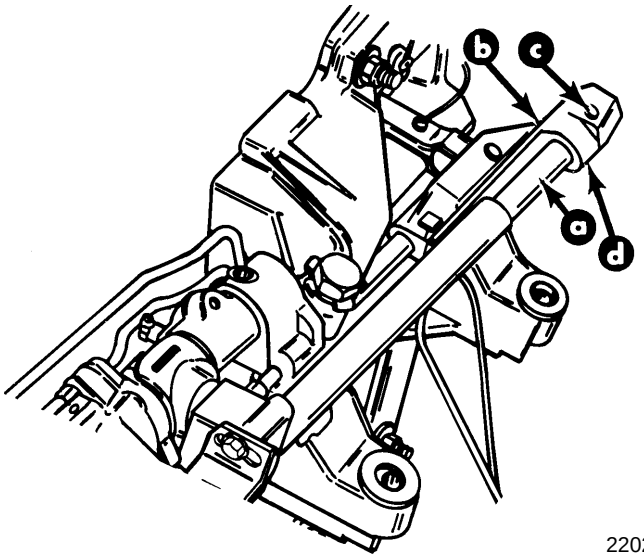
NOTE: *If using a test tank or if boat is in the water, ensure sterndrive unit gear housing water intake holes are below water level.*

6. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.
7. Start engine and run at idle. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
8. Position drive unit so that it is straight back and then stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse, then check fluid level and add fluid, if needed. DO NOT OVERFILL. Reinstall fill cap and tighten securely.
9. If fluid was foamy in previous step, repeat steps 7 and 8 until fluid does not foam and level remains constant.

Balancing Power Steering Control Valve

IMPORTANT: Control valve is balanced by the manufacturer and should not require further adjustment. However, if drive unit tends to creep in one direction or the other (with engine running, drive unit in neutral, and hands off the steering wheel), the control valve MUST BE balanced as explained following.

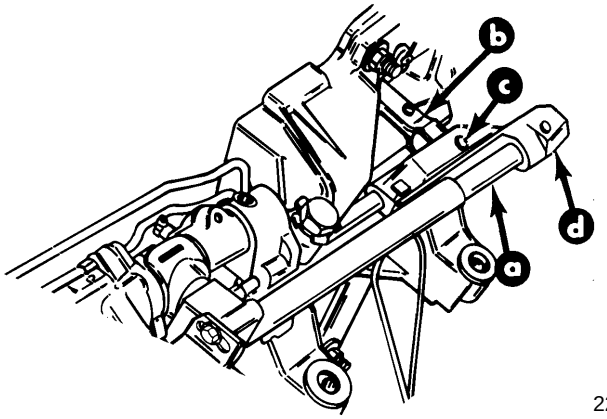
1. Ensure engine is off.
2. Disconnect steering cable from power steering control valve clevis.



22023

a - Steering Cable
b - Clevis
c - Pin
d - Cotter Pin

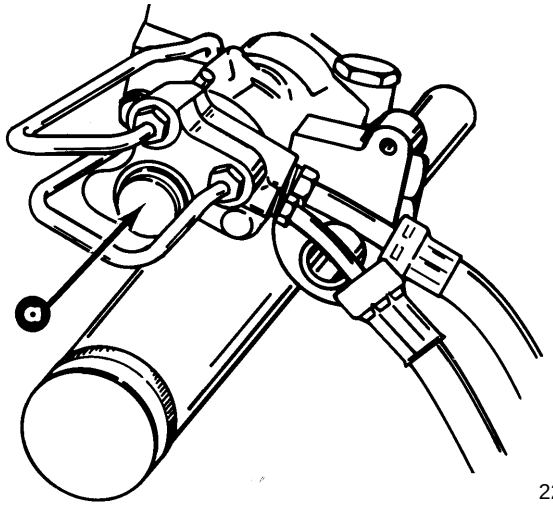
3. Disconnect power steering control valve clevis from drive unit steering lever.



22023

a - Clevis
b - Steering Lever
c - Pin
d - Cotter Pin (Hidden)

4. Remove dust cover.



22023

a - Dust Cover

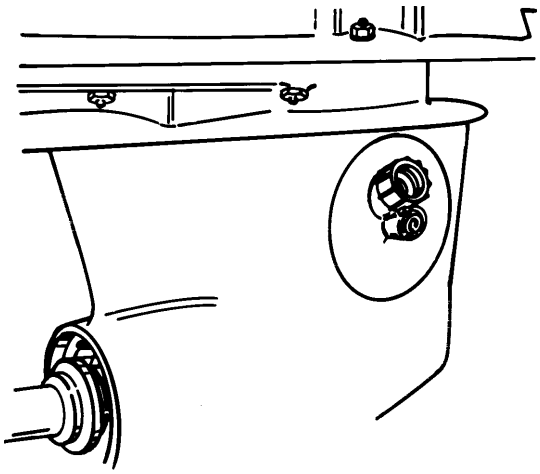
⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup holes in gear housing. Overheating damage to engine may result.

⚠WARNING

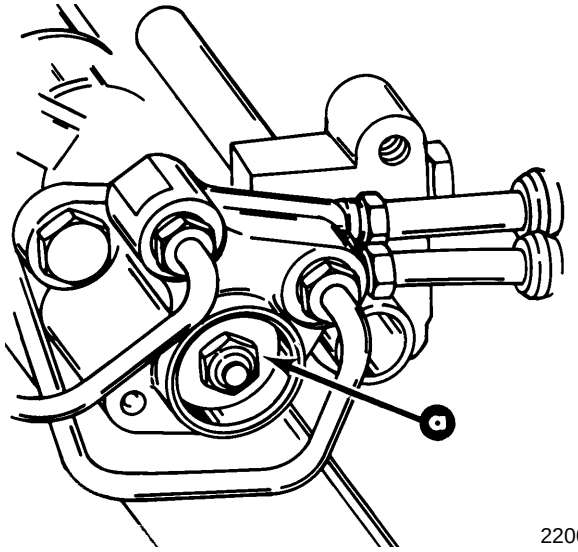
Remain clear of power steering clevis when starting engine. If control valve is not balanced, unexpected movement of clevis could cause injury.

5. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

6. Start engine and adjust control valve by turning adjustment nut as follows:



220023

a - Adjustment Nut

   a. **If power steering piston rod end clevis moves toward right (starboard),** turn nut clockwise until clevis just begins to move toward left (port), then turn nut counterclockwise until clevis just begins to move toward right (starboard). Turn nut clockwise to exactly 1/2 the rotation necessary to change direction of rod end clevis movement.

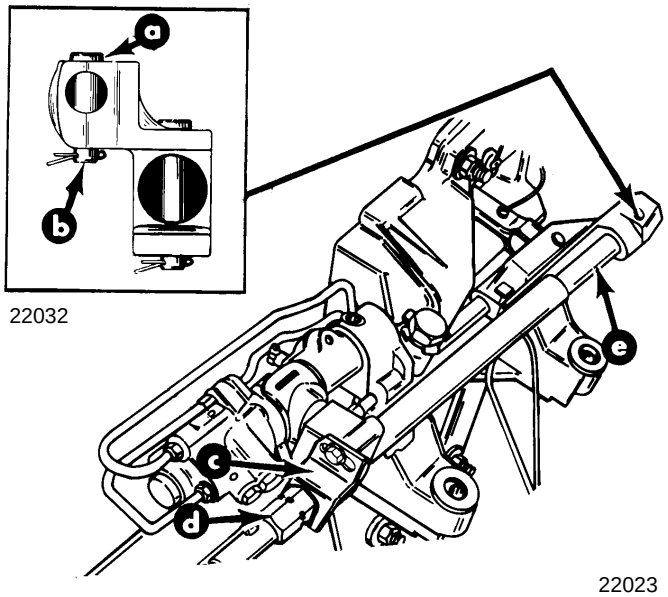
   b. **If power steering piston rod end clevis moves toward left (port),** turn nut counterclockwise until clevis just begins to move toward right (starboard), then turn nut clockwise until clevis just begins to move toward left (port). Turn nut counterclockwise to exactly 1/2 the rotation necessary to change direction of rod end clevis movement.

7. Turn off engine.

8. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.

9. Torque coupler nut to 35 lb. ft. (48 N·m).

10. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.

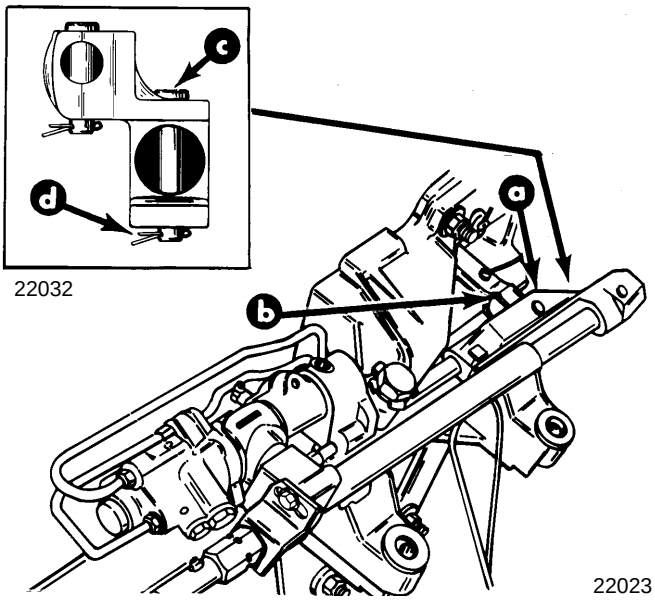


22032

22023

a - Clevis Pin
b - Cotter Pin
c - Locking Plate
d - Coupler Nut
e - Steering Cable

11. Reconnect power steering control valve piston rod end clevis to drive unit steering lever.

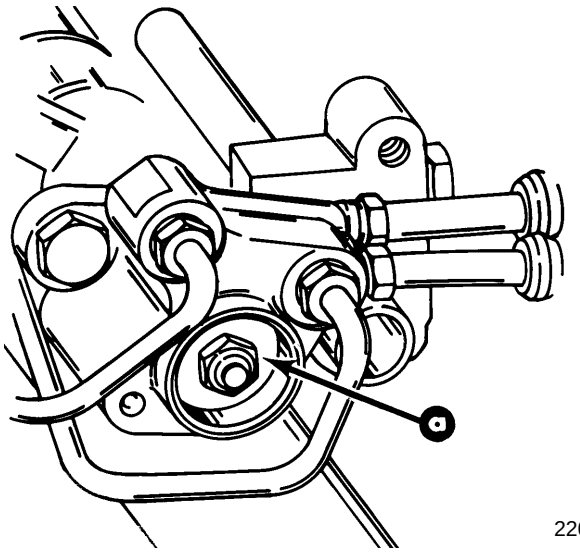


22032

22023

a - Clevis
b - Steering Lever
c - Pin
d - Cotter Pin

12. Place 2-4-C Marine Lubricant in adjustment nut cavity and reinstall dust cover.



22023

a - Adjustment Nut Cavity

13. Restart engine and observe drive unit. If drive unit still creeps in one direction or the other, an external tension may exist on steering cable. Ensure that nothing is attached to steering cable (pushing or pulling).

Power Steering Drive Belt Inspection

1. Inspect Power Steering pump drive belt on engine for excessive wear, cracks, fraying, and glazed surfaces. Check belt tension using either of the two methods following:

   a. Using a strand tension gauge, take gauge reading at mid-point of Power Steering pump drive belt. Reading should be 75-95 lbs. (334-423 N).

   b. Check belt tension by pushing down on upper strand of belt at mid-point of Power Steering pump drive belt. Belt should depress 1/2 in. (13 mm).

2. Adjust belt, if required.

Steering Cable Selection, Removal and Installation

Selection

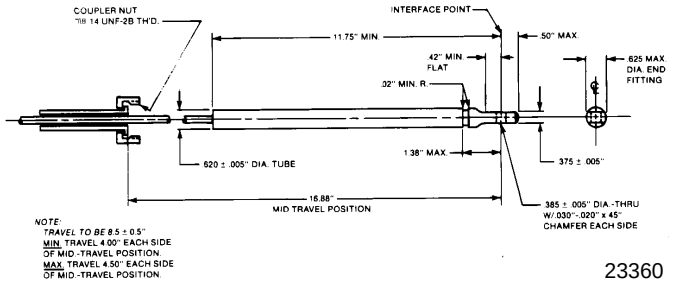
Steering system has the steering cable guide tube set for cables with end dimensions which comply with the BIA Certification Handbook.

⚠CAUTION

If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result.

⚠CAUTION

Steering cables MUST BE THE CORRECT LENGTH, particularly when installed in large boats. Sharp bends or too-short cables result in kinks; too-long cables require unnecessary bends and/or loops. Both place an extra stress on the cable. The proper cable is as short as possible, with the fewest bends and with radii as large as possible.

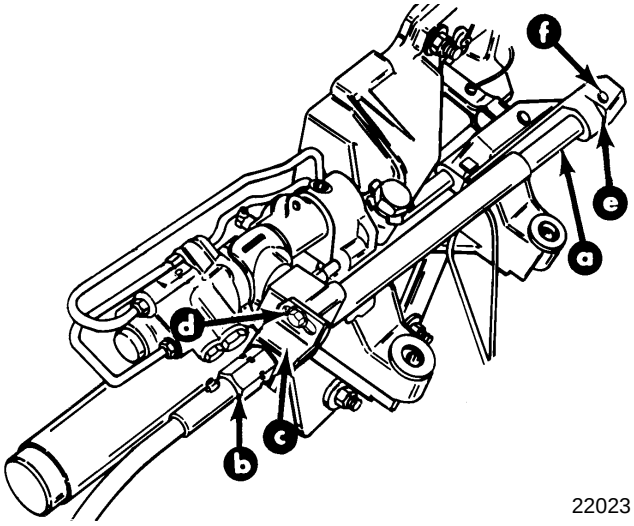

COUPLER NUT
7/8-14 UNF-2B THD.
INTERFACE POINT
11.75" MIN.
.50" MAX.
.42" MIN. FLAT
.625 MAX. DIA. END FITTING
.02" MIN. R.
1.38" MAX.
.620 ± .005" DIA. TUBE
.375 ± .005"
16.88" MID TRAVEL POSITION
.385 ± .005" DIA.-THRU W/.030"-.020" x 45° CHAMFER EACH SIDE
NOTE:
TRAVEL TO BE 8.5 ± 0.5"
MIN. TRAVEL 4.00" EACH SIDE OF MID.-TRAVEL POSITION.
MAX. TRAVEL 4.50" EACH SIDE OF MID.-TRAVEL POSITION.

23360

Steering Cable End Dimension

Removal

1. Remove steering cable.



22023

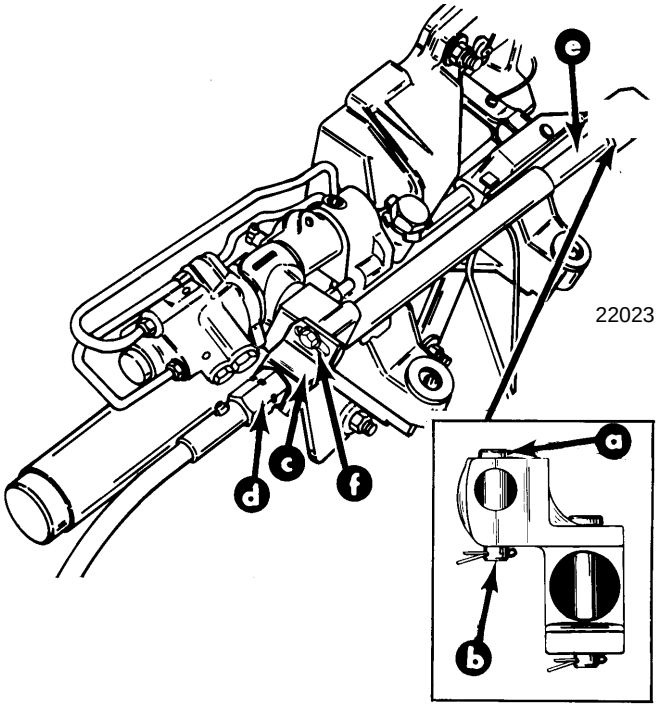
a - Steering Cable
b - Cable Coupler Nut
c - Lock Plate
d - Screw And Washer
e - Cotter Pin
f - Clevis Pin

Installation

⚠WARNING

Steering cable outer casing MUST BE free to move back-and-forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

1. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
2. Torque coupler nut to 35 lb. ft. (48 N·m).
3. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.



22023

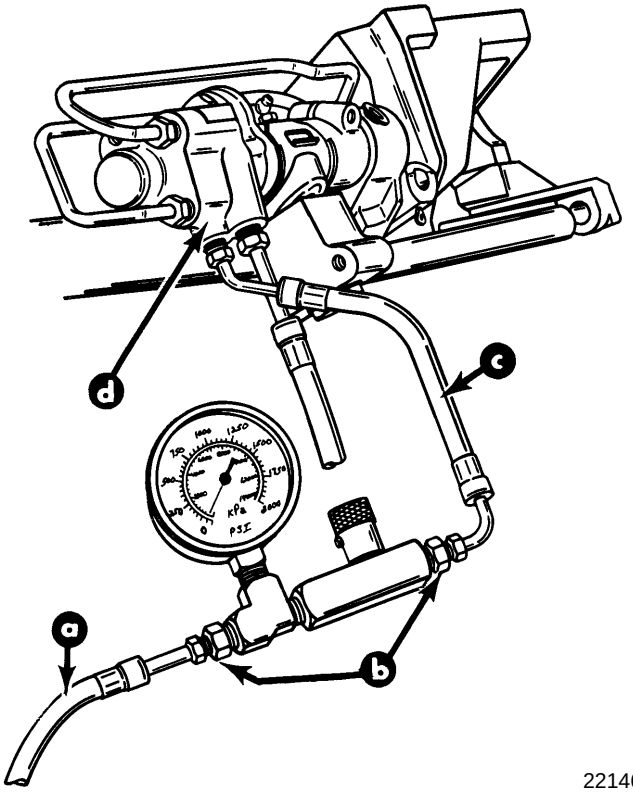
22032

a - Clevis Pin
b - Cotter Pin
c - Locking Plate
d - Coupler Nut
e - Steering Cable
f - Self Locking Bolt And Washer

Testing Power Steering System

Test Gauge Assembly

1. Assemble gauge.
2. Install test gauge assembly between control valve and pump pressure hose. Tighten all fittings securely, but DO NOT OVERTIGHTEN.



22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

Power Steering Pump Lugging Test

⚠CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

⚠WARNING

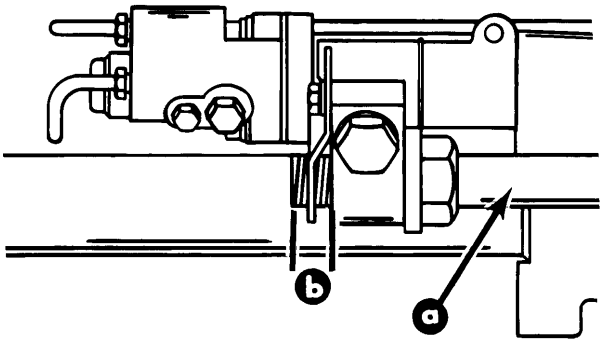
Steering cable outer casing MUST BE free to move back-and-forth for Power Steering to function properly. Make sure that no wires, cables, or other items are fastened to steering cable, as this may prevent it from moving.

⚠CAUTION

If Power Steering pump lugs when steering wheel is turned to end of travel in either direction (left or right), damage to steering system and/or sterndrive may result.

IMPORTANT: Make sure that Power Steering pump is filled to proper level before proceeding.

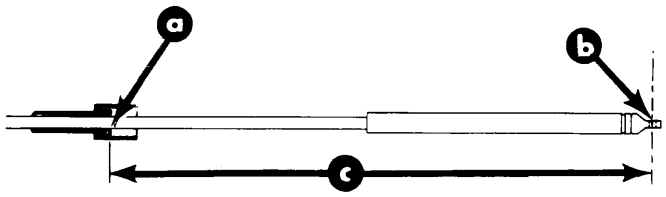
1. Completely open test gauge.
2. Start engine and run at idle speed.
3. Turn steering wheel to **hard left** and observe reading on gauge. If pressure reading is higher than 300 psi (2069 kPa), stop engine and check the following:
   a. Check for an obstruction between gimbal ring and gimbal housing and all moving steering system components.
   b. Check that steering lever is not contacting cut-out in transom. If contact is being made, modify cutout.
   c. Check steering cable guide tube dimensions and adjust as necessary.



22137

a - Steering Cable Guide Tube
b - 5/8-7/8 in. (16-22 mm) [Ideal 3/4 In. (19 mm)]

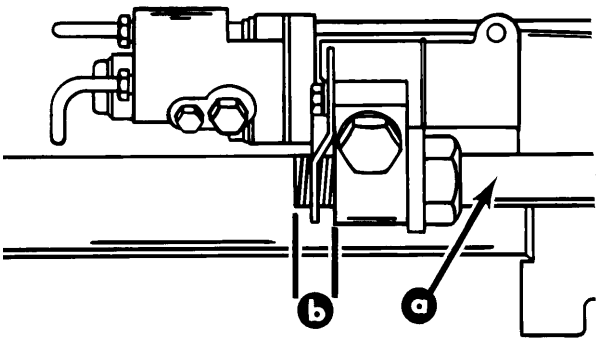
4. With engine running, turn steering wheel to **hard right** and observe reading on gauge. If reading is higher than 300 psi (2069 kPa), stop engine and check the following.
   a. Check for an obstruction between gimbal ring, and gimbal housing and all moving steering system components.
   b. Check that steering lever is not contacting cut-out in transom. If contact is being made, modify cutout.
   c. Check steering cable end dimensions with cable fully extended. If excessive, replace cable and/or steering head as required.



22469

a - Steering Cable Mounting Flange
b - Center Of Hole In Steering Cable End
c - 21-3/8 in. (543 mm)

   d. Check steering cable guide tube dimension and adjust as necessary.



22137

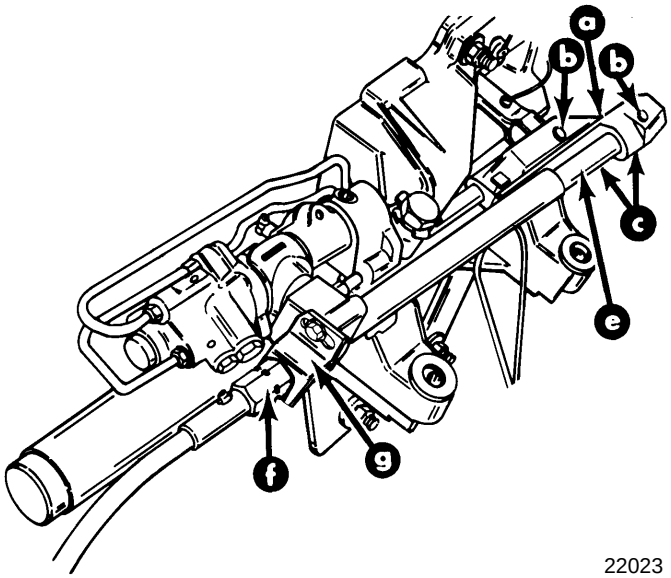
a - Steering Cable Guide Tube
b - 5/8-7/8 (16-22 mm) [Ideal 3/4 In. (19 mm)]

Power Steering System Pressure Test

IMPORTANT INFORMATION

The following instructions are arranged so that a defective part can be detected by the process of elimination. It is suggested that the order of the instructions be followed so that the Power Steering System can be tested effectively.

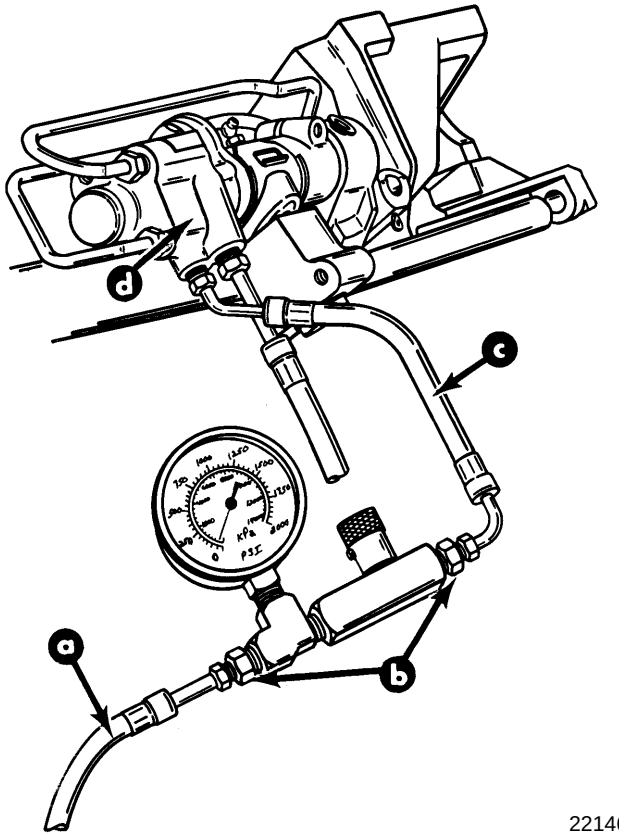
1. Remove steering cable from Power Steering unit and disconnect Power Steering unit from steering lever.



22023

a - Clevis
b - Pins (2)
c - Cotter Pins (2)-Hidden
d - Steering Lever
e - Steering Cable
f - Coupler Nut
g - Locking Plate

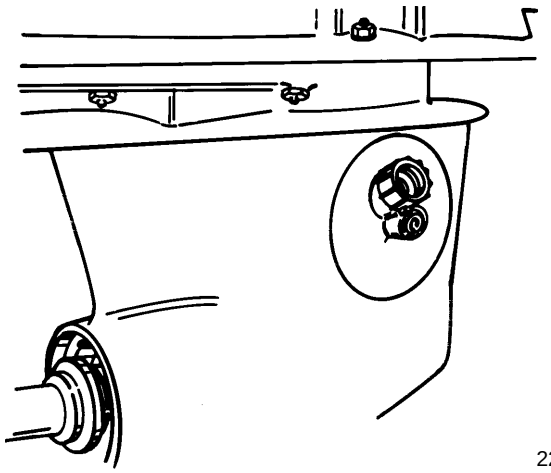
2. Assemble and install test gauge.
3. Open valve on gauge completely.



22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

4. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow cooling system to fill completely. Cooling system is full when water is discharged through the propeller. DO NOT use full water tap pressure.



22029

5. Start engine and run at 1000-1500 RPM until engine reaches normal operating temperature.
6. With engine at idle speed, test gauge reading should be between 70 and 125 psi (483 and 862 kPa). If not, proceed as follows:

   If lower than 70 psi (483 kPa): proceed to “Pump Pressure Test”, see “Index”.

   If higher than 125 psi (862 kPa): check for hose restrictions in the system.

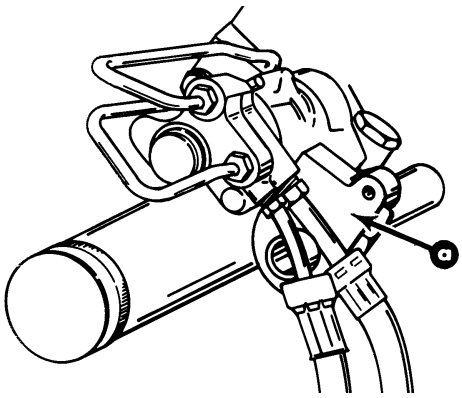
⚠CAUTION

DO NOT lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

7. Push control valve adaptor block **momentarily** to the **left** and then to the **right**. Gauge reading should show an instant increase in pressure when block is pushed in both directions.
8. Push control valve adaptor block to the **right**, until booster cylinder piston rod is fully retracted. With piston rod in this position, **momentarily** push adaptor block to the **right** until maximum pressure reading is obtained.

If pressure is above 1000 psi (6897 kPa): system pressure is good.

If pressure is below 1000 psi (6897 kPa): conduct “Pump Pressure Test”, see “Index”.



22023

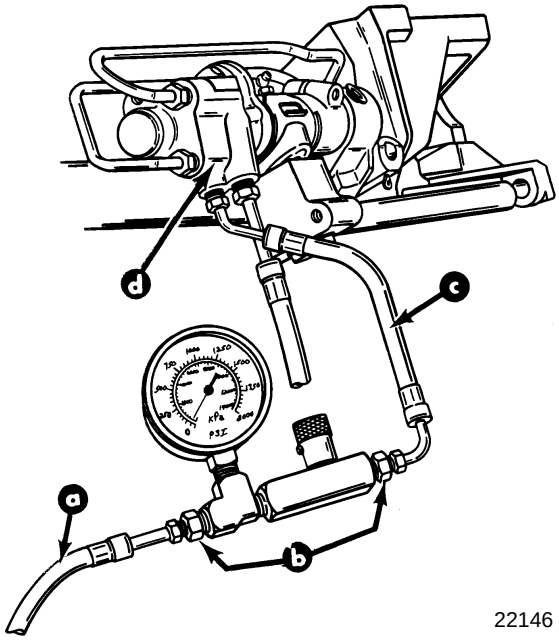
a - Control Valve Adaptor Block

Pump Pressure Test

⚠CAUTION

In performing the following test, DO NOT lug pump at maximum pressure for more than 5 seconds or damage to Power Steering pump may occur.

1. Install test gauge.



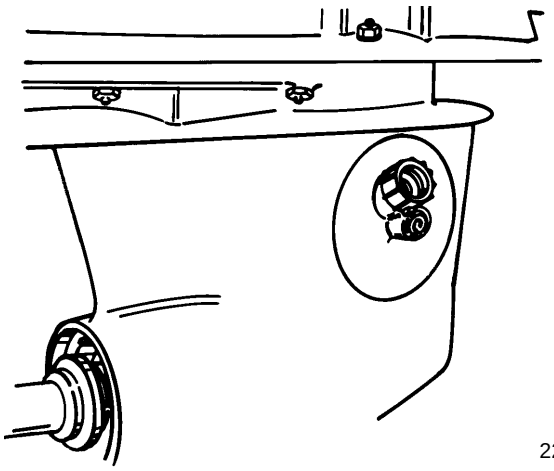
22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

⚠CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

2. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

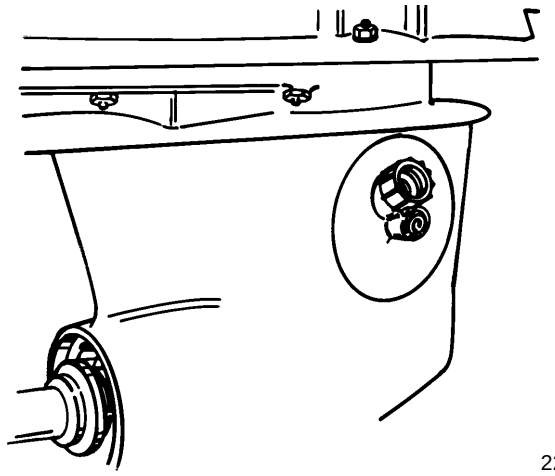
3. Start engine and run at 1000-1500 RPM until engine reaches normal operating temperature.
4. Close test gauge valve just long enough to obtain maximum pressure reading.
5. Close and open valve 3 times. Record highest pressure reading attained each time.
   a. **If pressure readings are between 1150 and 1250 psi (7932-8621 kPa) and are within a range of 50 psi (345 kPa):** the pump is within specifications. If the **pump** tests OK, but system pressure was low (as tested under “Power Steering System Pressure Test”, see “Index”), proceed to “Booster Cylinder Test”, see “Index”.
   b. **If pressure readings are between 1150-1250 psi (7932-8621 kPa), but are not within a 50 psi (345 kPa) range:** the Power Steering pump flow control valve is sticking or pump hydraulic system is dirty.
   c. **If pressure readings are constant, but below 1000 psi (6897 kPa):** replace Power Steering pump.

Booster Cylinder Test

⚠CAUTION

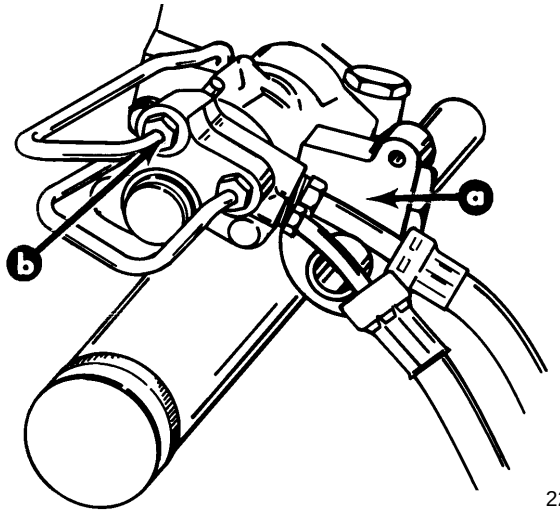
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

1. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

2. Start engine.
3. Push control valve adaptor block to the right until booster cylinder rod is fully retracted.
4. Stop engine.
5. Remove top metal hydraulic line from control valve.
6. Plug port in control valve and cap end of metal line with cap and plug supplied in test gauge kit.



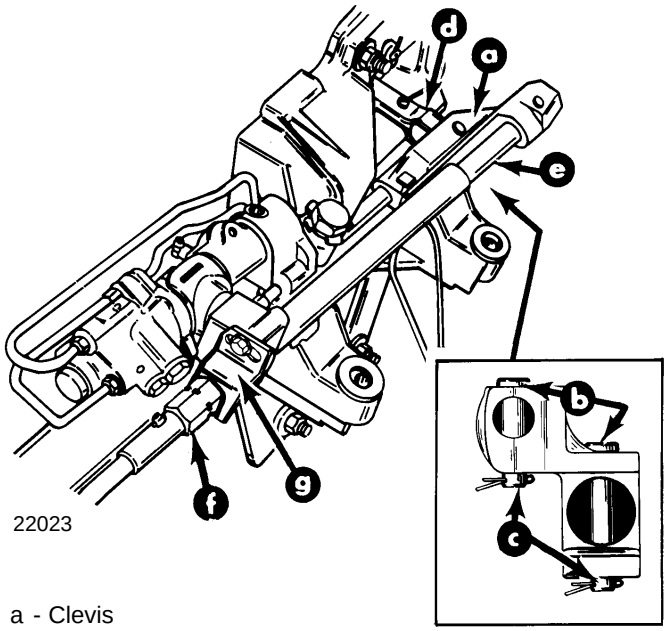
22023

a - Adaptor Block
b - Top Metal Line

⚠CAUTION

DO NOT lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

7. Start engine.
8. Push control valve adaptor block momentarily to the right and observe for conditions “a” or “b”, following:
   a. **If piston rod extends,** booster cylinder is leaking and must be replaced. After replacement, repeat “Power Steering System Pressure Test”. If pressure is still low, replace control valve.
   b. **If piston rod does not extend, but pressure was low when performing “Power Steering System Pressure Test”,** replace control valve.
9. Stop engine.
10. Connect power steering piston rod clevis to drive unit steering lever. Secure with pin and cotter pin.
11. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
12. Torque coupler nut to 35 lb. ft. (48 N·m).
13. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.



22023

22032

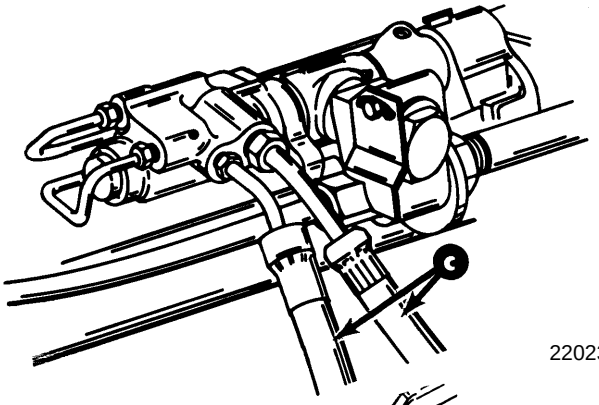
a - Clevis
b - Pins (2)
c - Cotter Pins (2)
d - Steering Lever
e - Steering Cable
f - Coupler Nut
g - Locking Plate

Power Steering Component Repair

Power Steering Unit

REMOVAL

1. Remove steering cable and Power Steering pump fluid hoses. Plug power steering pump hoses.



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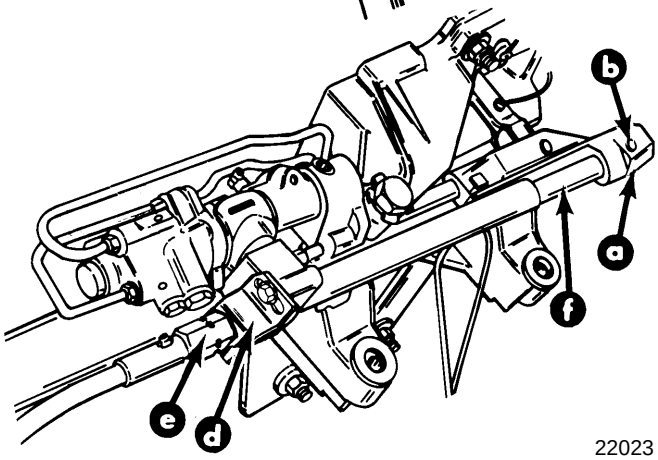
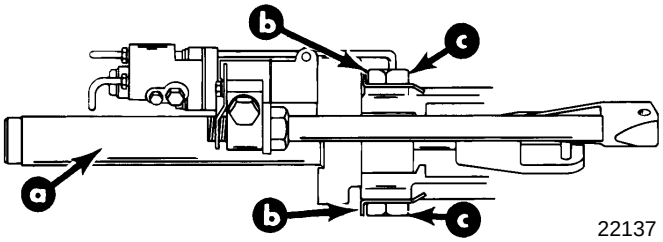


22023

a - Cotter Pin (Hidden)
b - Clevis Pin
c - Power Steering Pump Fluid Hoses
d - Coupler Unit Lock
e - Cable Coupler Nut
f - Steering Cable

2. Remove Power Steering unit. Bend tab washer away from pivot bolt.

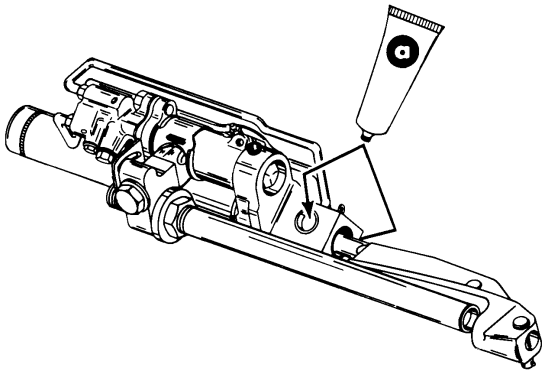


22137

a - Power Steering Unit
b - Tab Washer
c - Pivot Bolt

INSTALLATION

1. Lubricate power steering unit bushings with Special Lubricant 101.



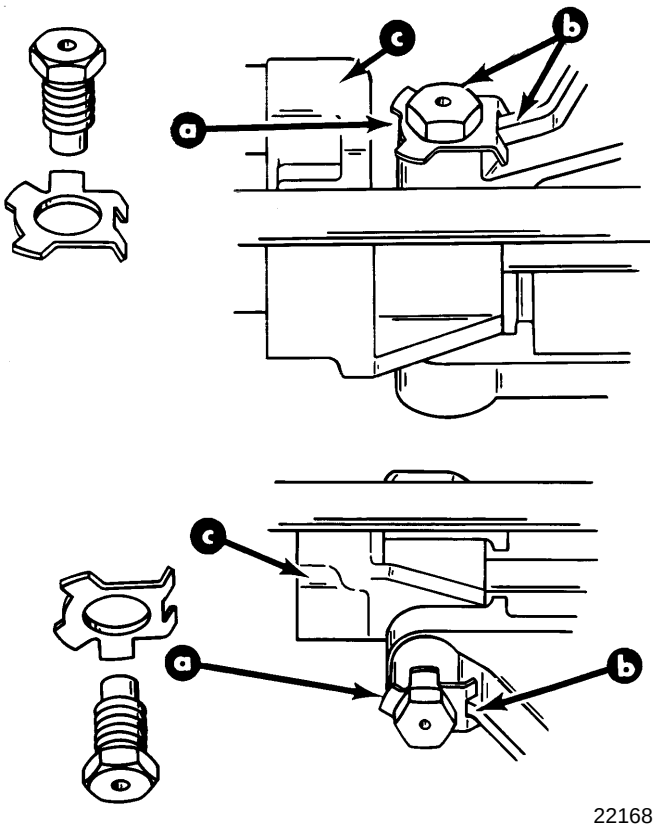
22167

a - Bushings

2. Lubricate pivot bolts with Special Lubricant 101.
3. HAND THREAD pivot bolts all-the-way into inner transom plate and swivel ring. DO NOT use a wrench.

NOTE: *Some earlier "R" models had a pin and cotter pin in place of pivot bolts.*

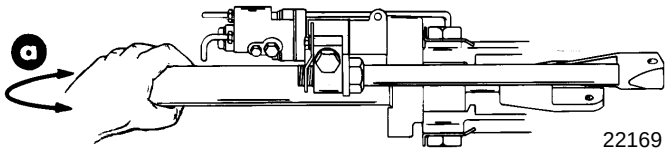
4. Straddle tab washer tangs on inner transom plate ridge.



22168

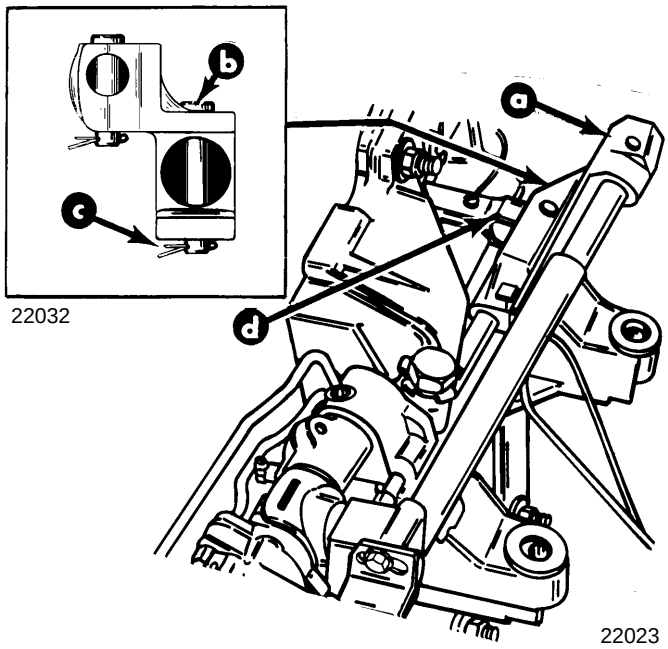
a - Pivot Bolts
b - Tab Washer
c - Swivel Ring

5. Torque pivot bolts to 25 lb. ft. (35 N·m). Bend washer tabs against corresponding flats on bolt tabs.
6. Move power steering unit back-and-forth to ensure that it pivots freely.



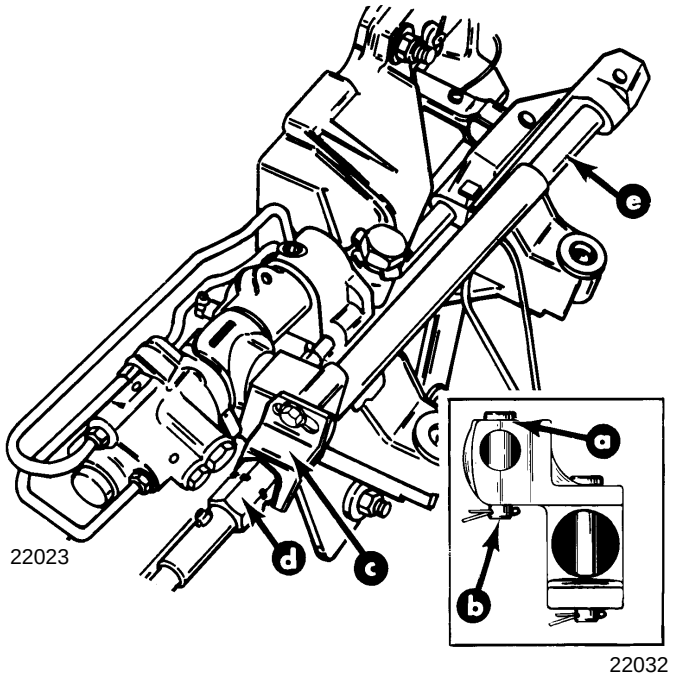
a - Move Power Steering Unit Back And Forth

7. Connect power steering piston rod clevis to drive unit steering lever. Secure with pin and cotter pin.



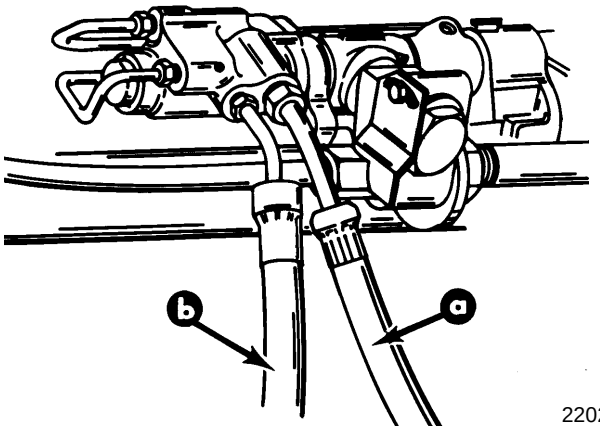
a - Clevis
b - Pin
c - Cotter Pin
d - Steering Lever

8. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
9. Torque coupler nut to 35 lb. ft. (48 N·m).
10. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.



a - Clevis Pin
b - Cotter Pin
c - Lock Plate
d - Coupler Nut
e - Steering Cable

11. Connect power steering pump hoses to their respective fittings on control valve. Torque large fitting to 20-25 lb. ft. (27-34 N·m). Torque small fitting to 96-108 lb. in. (11-12 N·m).

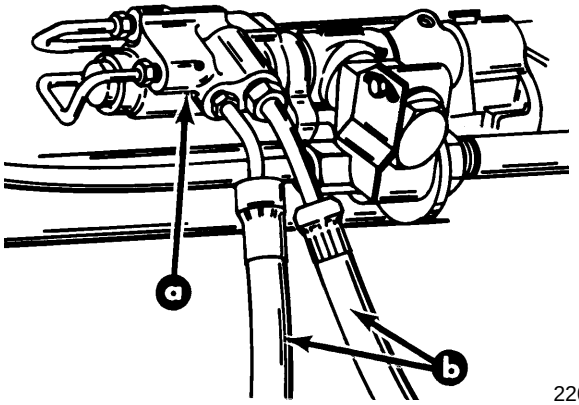


a - Hose (Large Fitting)
b - Hose (Small Fitting)

Cable Guide Tube

REMOVAL

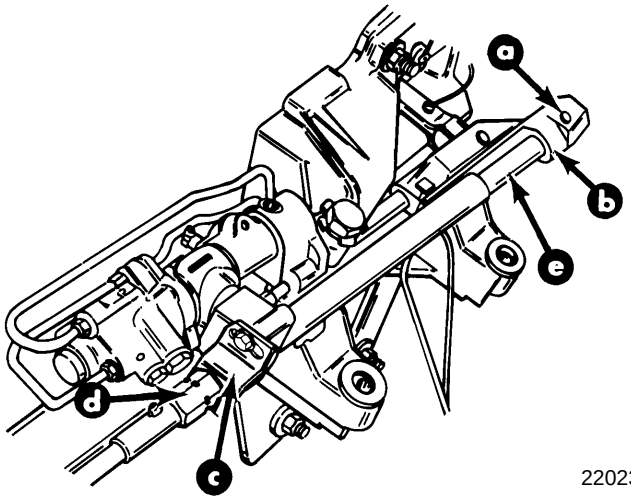
1. Remove power steering pump hoses from control valve. Cap hoses and plug holes in control valve.



22023

a - Control Valve
b - Pump Hoses

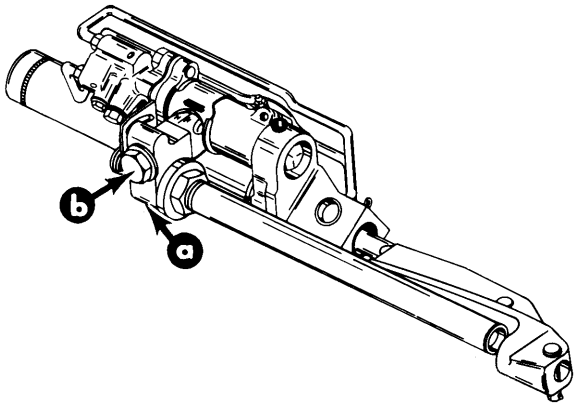
2. Remove steering cable from power steering control valve.



22023

a - Clevis Pin
b - Cotter Pin (Hidden)
c - Locking Plate
d - Coupler Nut
e - Steering Cable

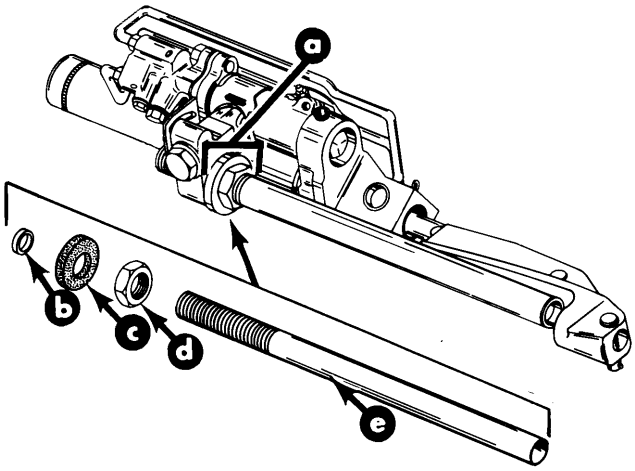
3. Remove adaptor block as follows:
   a. Loosen adaptor block nut.
   b. Tap adaptor nut with hammer to loosen block.
   c. Remove nut; then remove block.



22137

a - Adaptor Block
b - Nut

4. Heat area shown (to break down Loctite), and remove steering tube bushing, guide, and nut. Remove cable guide tube.



22137

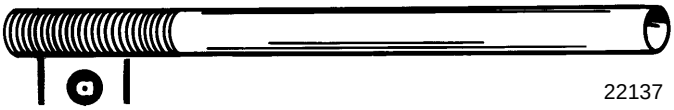
a - Heat In This Area
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - Cable Guide Tube

INSTALLATION

⚠WARNING

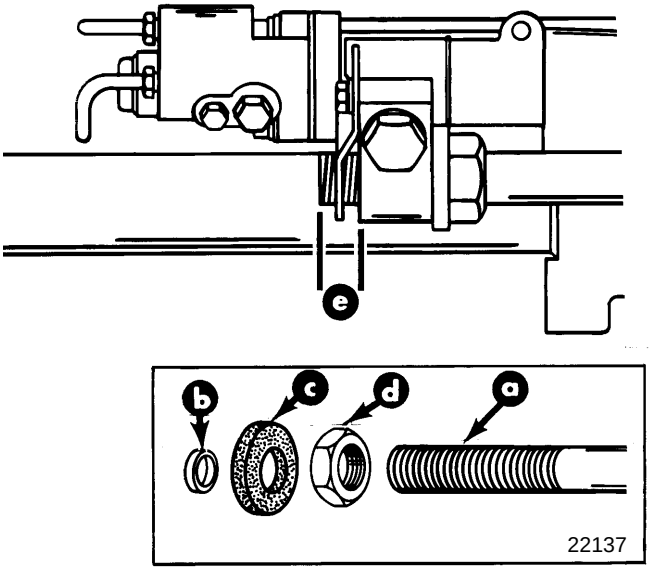
Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

1. Clean guide tube threads with a wire brush to remove old Loctite. Spray threads with Locquic Primer “T”. After primer has dried (approximately 10 minutes), apply a liberal amount of Loctite No. 35 to guide tube threads (in area where adaptor block and locknut will be installed).



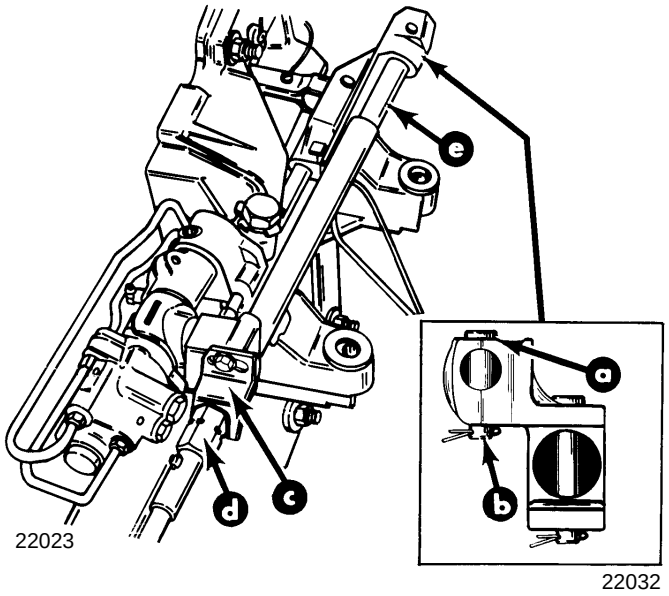
a - Application Area

2. Reinstall steering tube and related hardware and position so that threaded end of tube protrudes exactly 3/4 in. (19 mm) through adaptor block. Torque steering tube nut to 15-20 lb. ft. (20-27 N·m).



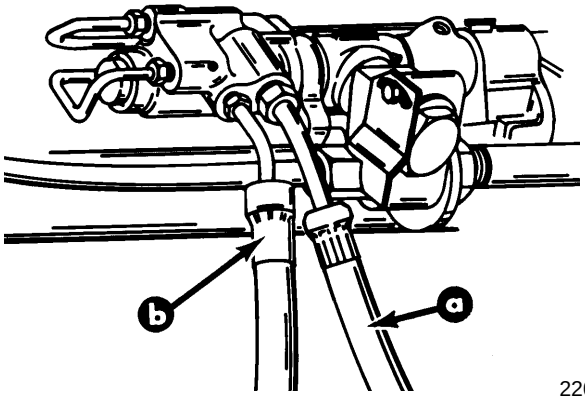
a - Steering Guide Tube
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - 3/4 In. (19 mm)

3. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
4. Torque coupler nut to 35 lb. ft. (48 N·m).
5. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.



a - Clevis Pin
b - Cotter Pin
c - Locking Plate
d - Coupler Nut
e - Steering Cable

6. Connect power steering pump hoses to their respective fittings on control valve. Torque large fitting to 20-25 lb. ft. (27-34 N·m). Torque small fitting to 96-108 lb. in. (11-12 N·m).



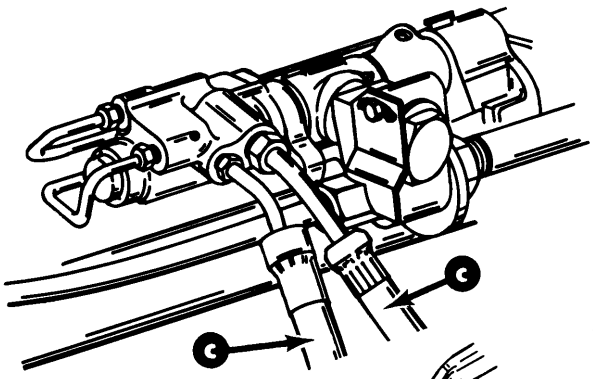
a - Hose (Large Fitting)
b - Hose (Small Fitting)

Control Valve

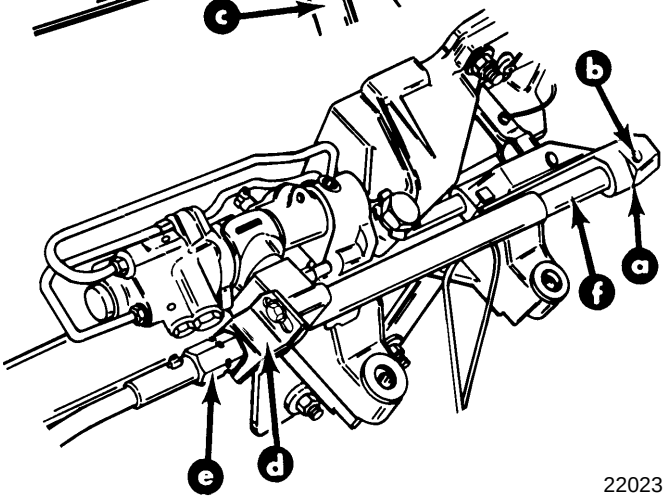
NOTE: *If accessibility to control valve area is limited, remove Power Steering unit from transom assembly, to gain easier access to control valve.*

REMOVAL

1. Remove steering cable and Power Steering pump fluid hoses. Plug Power Steering pump fluid hoses.



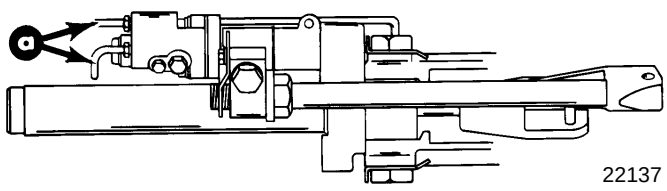
22023



22023

a - Cotter Pins (Hidden)
b - Clevis Pins
c - Power Steering Pump Fluid Hoses
d - Coupler Unit Lock
e - Cable Coupler Nut
f - Steering Cable

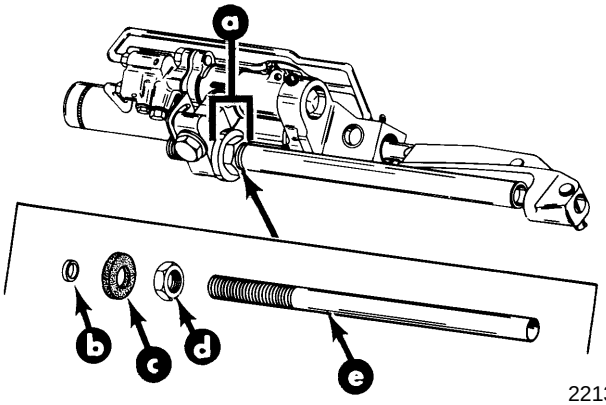
2. Remove tubes from control valve.



22137

a - Metal Tubes

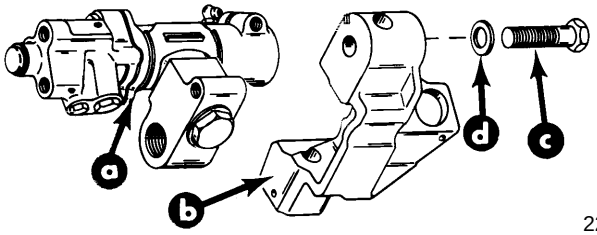
3. Heat area shown (to breakdown Loctite), and remove steering tube bushing, guide and nut.



22137

a - Heat this Area
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - Cable Guide Tube

4. Remove control valve from adaptor block assembly.

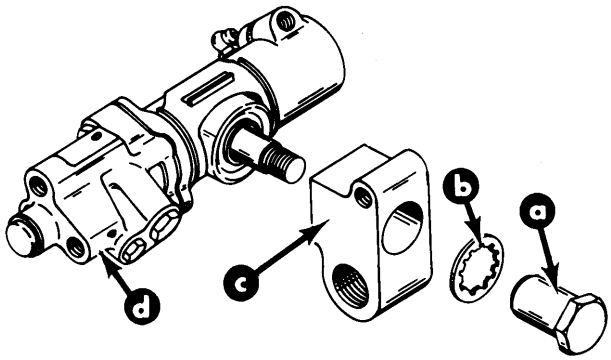


22143

a - Control Valve
b - Adaptor Block Assembly
c - Screw
d - Washer

DISASSEMBLY

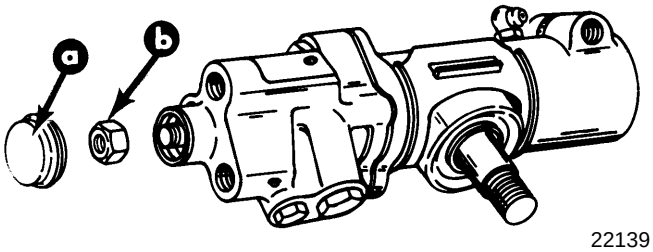
1. Remove adaptor block as follows:
   Loosen adaptor block nut. Tap adaptor nut with hammer to loosen block. Remove nut, washer and adaptor block.



22143

a - Adaptor Block Nut
b - Washer
c - Adaptor Block
d - Control Valve

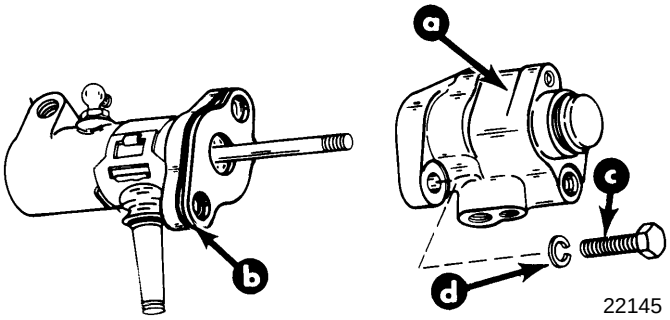
2. Remove dust cover and adjusting nut.



22139

a - Dust Cover
b - Adjusting Nut

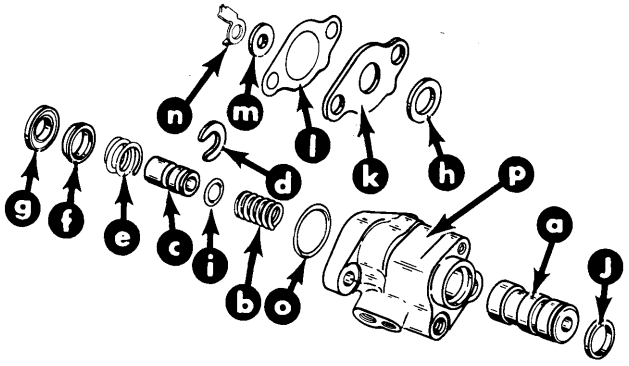
3. Separate valve housing from adaptor.



22145

a - Valve Housing
b - Adaptor
c - Screws (2)
d - Lock Washers (2)

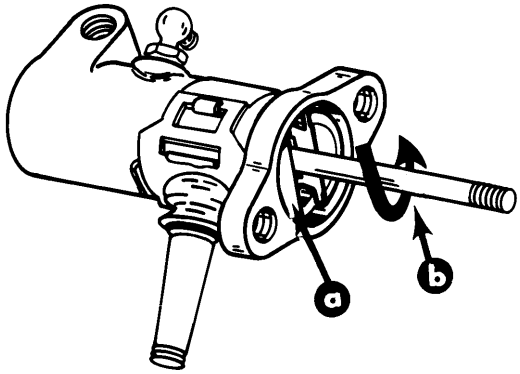
4. Remove components shown.



22138

a - Valve Spool
b - Valve Adjustment Spring
c - Reaction Spool
d - Spring Thrust Washer
e - Valve Spring
f - Spring Retainer
g - Annulus Seal
h - Large ID Washer
i - Reaction Spool O-ring
j - Valve Spool “V” Block Seal
k - Annulus Spacer
l - Gasket
m - Small Washer
n - Plug Sleeve Key
o - O-Ring
p - Valve Housing

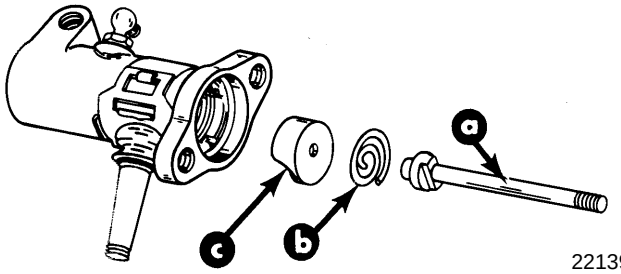
5. Carefully (so as not to nick the top surface) turn adjuster plug out of sleeve.



22139

a - Adjuster Plug
b - Turn Counterclockwise

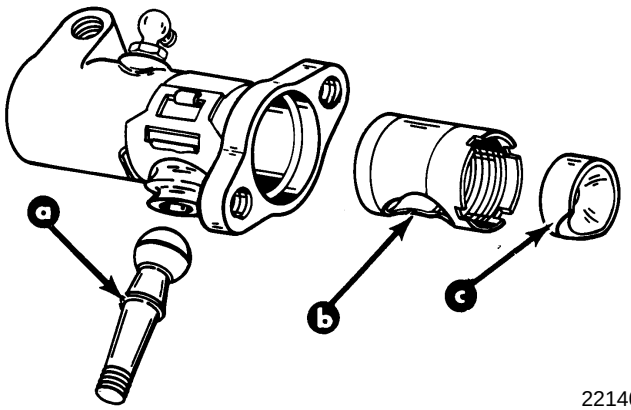
6. Remove components shown.



22139

a - Valve Shaft
b - Ball Seal Spring
c - Upper Ball Seat

7. Remove sleeve bearing and lower ball seat.



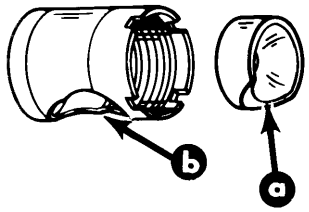
22140

a - Ball Stud-Pull Up into Rubber Boot
b - Sleeve Bearing
c - Lower Ball Seat

8. Clean and inspect metal parts. If any metal part shows signs of wear, replace control valve assembly.

REASSEMBLY

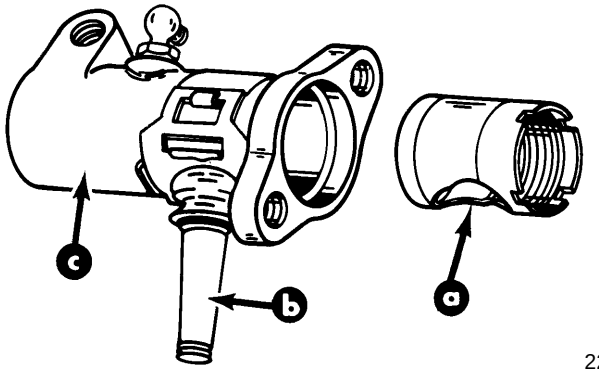
1. Install lower ball seat into sleeve bearing.



22140

a - Lower Ball Seat
b - Sleeve Bearing

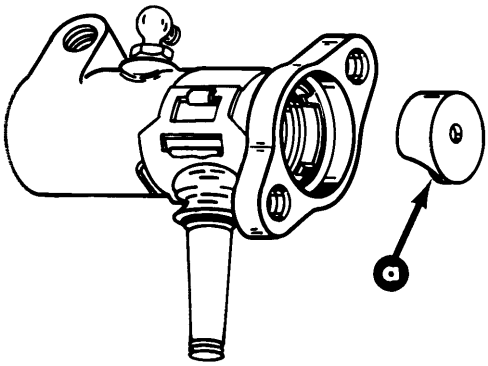
2. Install sleeve bearing. Pull ball stud up into rubber boot.



22140

a - Sleeve Bearing
b - Ball Stud
c - Adaptor Housing

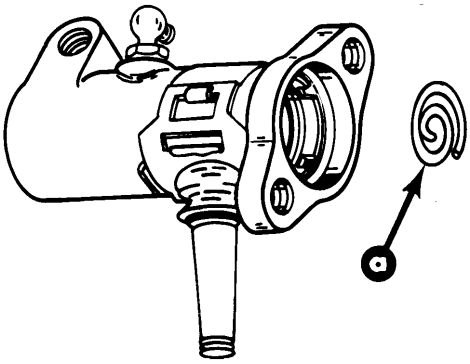
3. Position ball stud in sleeve bearing.
4. Install upper ball seat.



22141

a - Upper Ball Seat

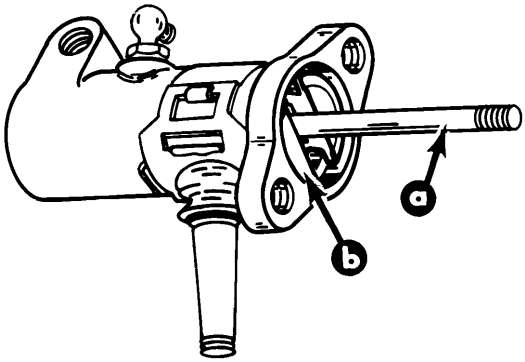
5. Install ball seat spring.



22141

a - Ball Seat Spring-Small Coil Down

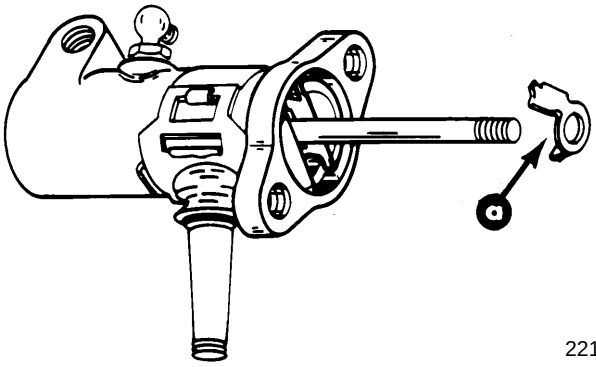
6. Insert valve shaft into adjuster plug. Screw adjuster plug into sleeve until tight; then back-off plug until slot lines up with notches in sleeve.



22139

a - Valve Shaft
b - Adjuster Plug

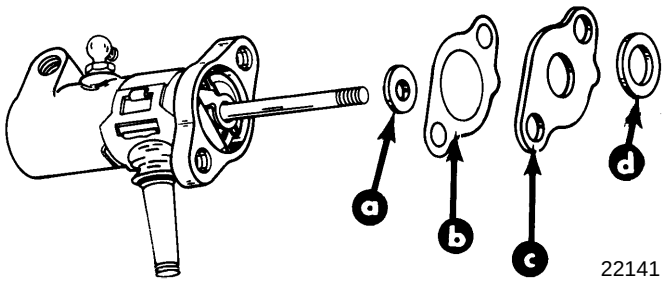
7. Install key. Fit key tangs into notches in sleeve.



22141

a - Key-Tangs

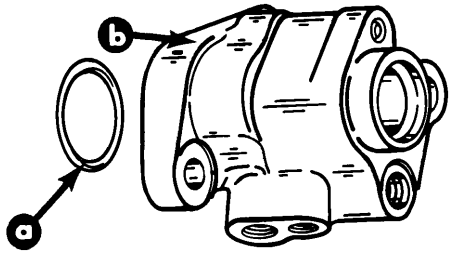
8. Install components shown.



22141

a - Valve Shaft Washer
b - Gasket
c - Annulus Spacer
d - Large ID Washer

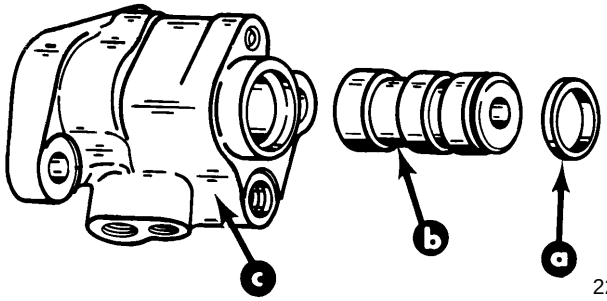
9. Install O-ring in control valve housing.



22142

a - O-ring
b - Control Valve Housing

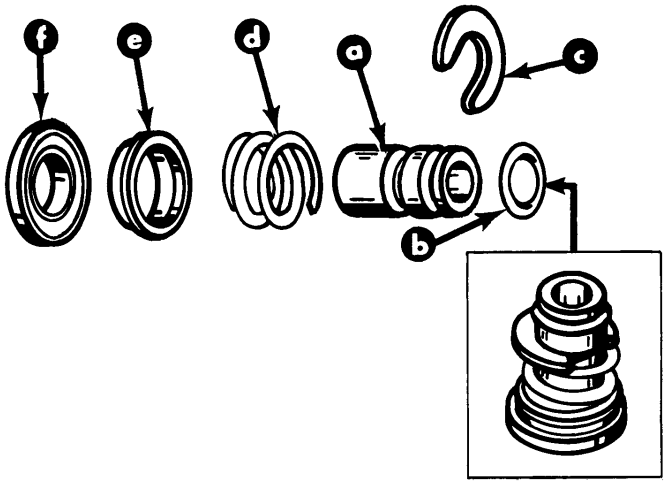
10. Install “V” block seal. Insert valve spool into adjusting nut end of control valve.



22142

a - “V” Block Seal-Lip Of Seal Facing Lands On Spool
b - Spool
c - Control Valve

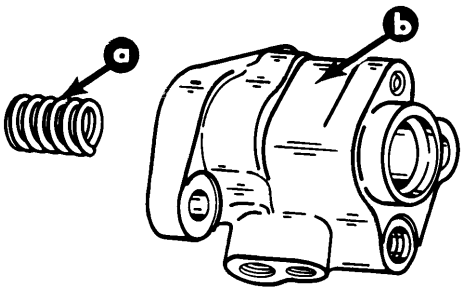
11. Assemble reaction spool.



22142

a - Reaction Spool
b - O-ring
c - thrust Washer
d - Valve Spring
e - Spring Retainer
f - Annulus Seal-Lip Facing O-ring End of Spool

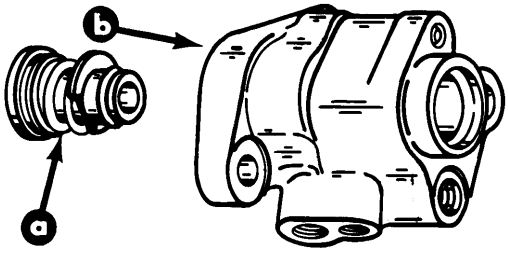
12. Install valve adjustment spring.



22142

a - Valve Adjustment Spring
b - Control Valve

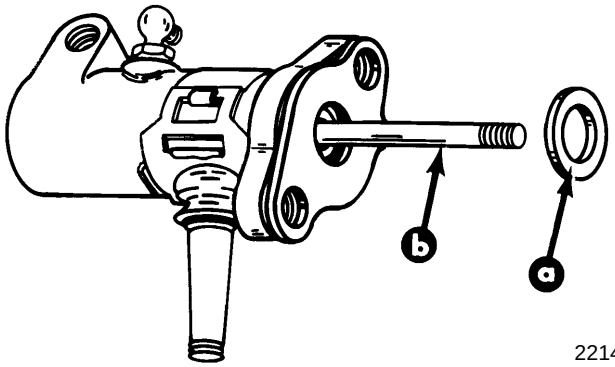
13. Install reaction spool assembly into larger control valve cavity.



22142

a - Reaction Spool Assembly
b - Control Valve-Large Cavity

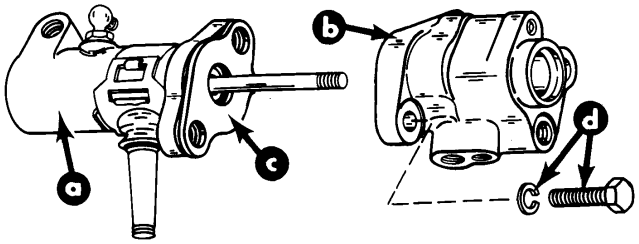
14. Install large ID washer.



22144

a - Large ID Washer
b - Valve Shaft

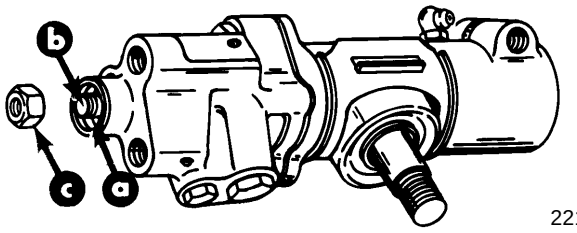
15. Match annulus spacer to control valve housing. Secure adaptor housing to control valve housing. Torque screws to 20-30 lb. ft. (27-41 N·m).



22144

a - Annulus Spacer
b - Control Valve Housing
c - Adaptor Housing
d - Screws And Washers (2 Each)

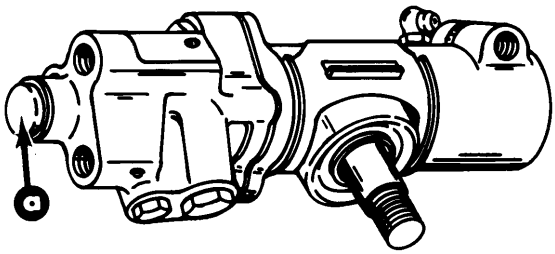
16. Depress valve spool. Install locknut-thread about 4 turns.



22139

a - Valve Spool
b - Valve Shaft
c - Locknut

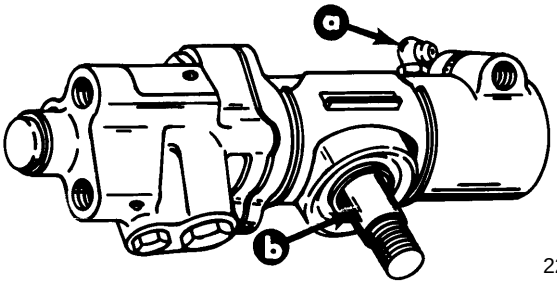
17. Install dust cover.



22143

a - Dust Cover

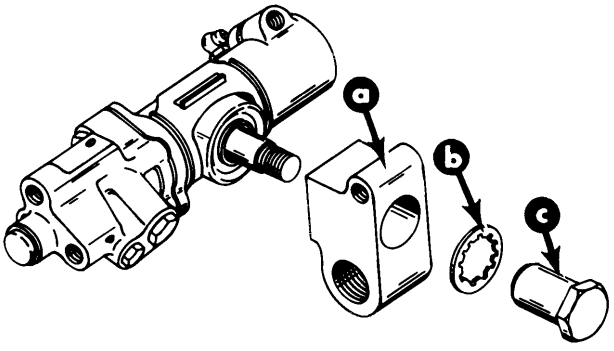
18. Lubricate control valve with Quicksilver 2-4-C until lubricant appears around rubber boot.



22143

a - Grease Fitting
b - Rubber Boot

19. Install adaptor block. Torque nut to 30-40 lb. ft. (41-54 N·m).

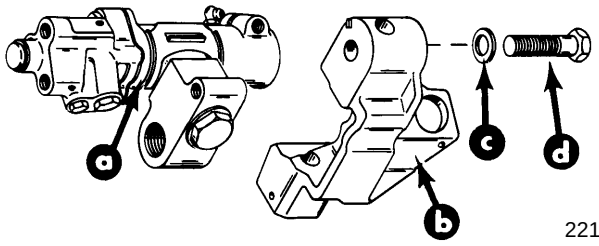


22143

a - Adaptor Block
b - Internal Lock Washer
c - Nut

INSTALLATION

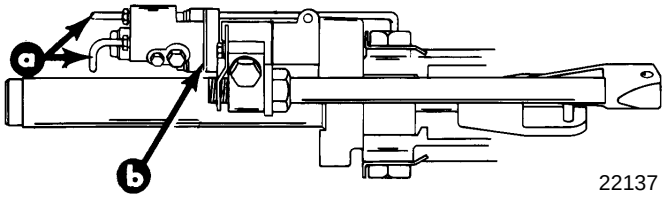
1. Secure control valve to adaptor block assembly. Torque screw to 25-35 lb. ft. (34-47 N·m).



22143

a - Control Valve
b - Adaptor Block Assembly
c - Washer
d - Screw

2. Install metal tubes onto control valve. Tighten securely but DO NOT overtighten.



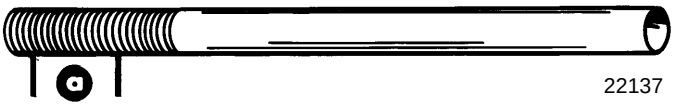
22137

a - Metal Tubes
b - Control Valve

⚠WARNING

Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

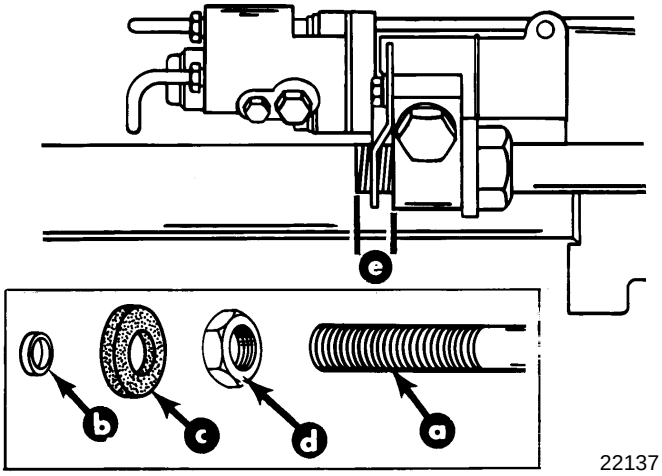
3. Clean guide tube threads with a wire brush to remove old Loctite. Spray threads with Loctite Primer "T". After primer has dried (approximately 10 minutes), apply a liberal amount of Loctite No. 35 to guide tube threads (in area where adaptor block and locknut will be installed).



22137

a - Application Area

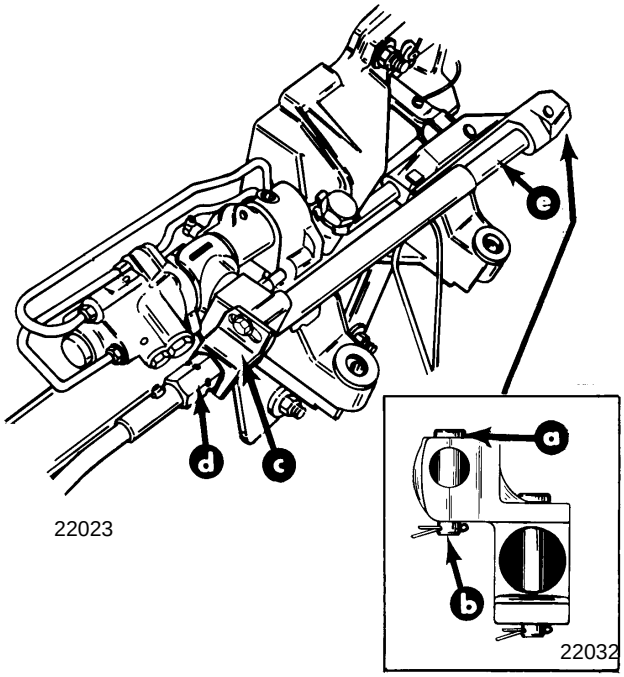
4. Reinstall steering tube and related hardware and position so that threaded end of tube protrudes exactly 3/4 in. (19 mm) through adaptor block. Torque steering tube nut to 15-20 lb. ft. (20-27 N·m).



22137

a - Steering Guide Tube
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - 3/4 In. (19 mm)

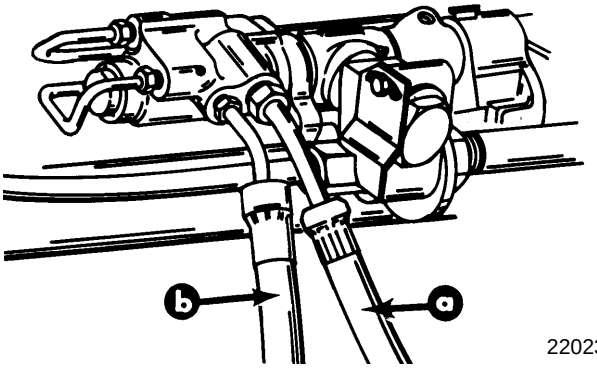
5. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
6. Torque coupler nut to 35 lb. ft. (48 N·m).
7. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.



22023
22032

a - Clevis Pin
b - Cotter Pin
c - Locking Plate
d - Coupler Nut
e - Steering Cable

8. Connect power steering pump hoses to their respective fittings on control valve. Torque large fitting to 20-25 lb. ft. (27-34 N·m). Torque small fitting 96-108 lb. in. (11-12 N·m).



22023

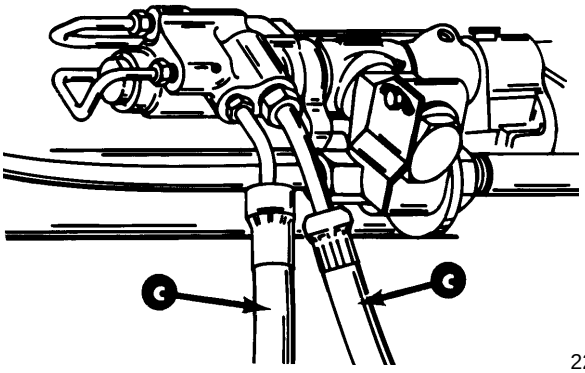
a - Hose (Large Fitting)
b - Hose (Small Fitting)

Booster Cylinder

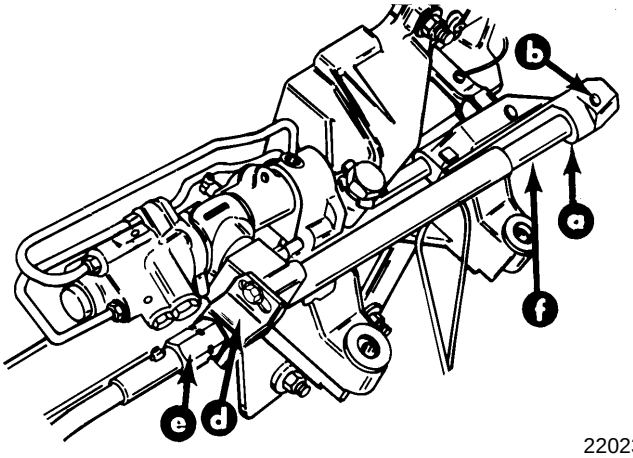
REMOVAL

NOTE: *If accessibility to booster cylinder area is limited, remove Power Steering unit from transom assembly to gain easier access to booster cylinder.*

1. Remove steering cable and Power Steering pump fluid hoses. **Plug power steering pump hoses.**



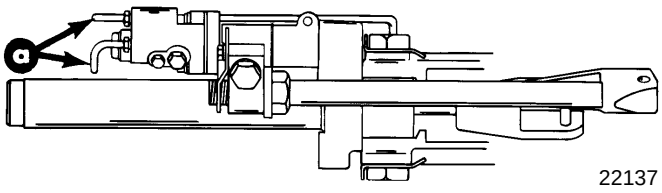
22023



22023

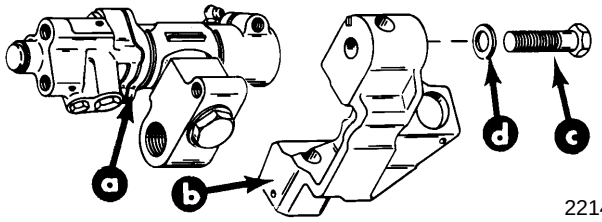
a - Cotter Pin (Hidden)
b - Clevis Pin
c - Power Steering Pump Fluid Hoses
d - Coupler Unit Lock
e - Cable Coupler Nut
f - Steering Cable

2. Remove metal lines from control valve.



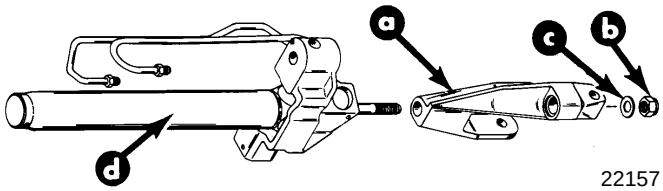
a - Metal Lines

3. Remove control valve from adaptor block assembly.



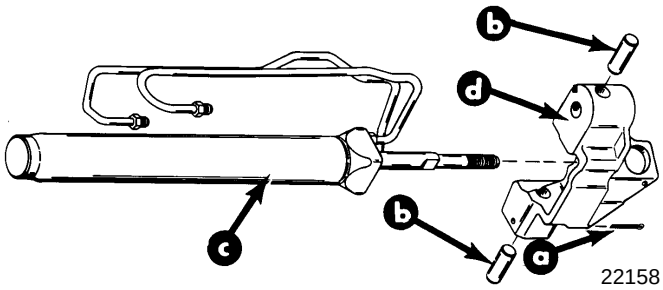
a - Control Valve
b - Adaptor Block Assembly
c - Screw
d - Washer

4. Remove clevis assembly.



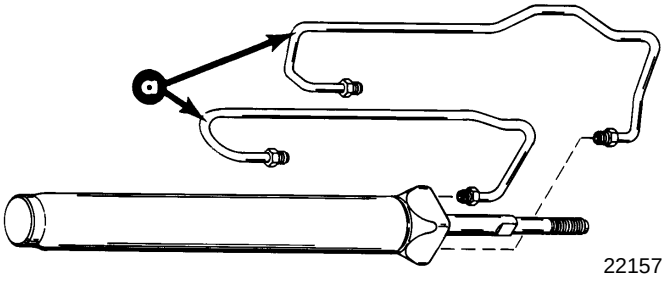
a - Clevis Assembly
b - Nut
c - Washer
d - Booster Cylinder

5. Separate booster cylinder from adaptor block assembly. Thread a screw of appropriate length into retaining pins and remove.



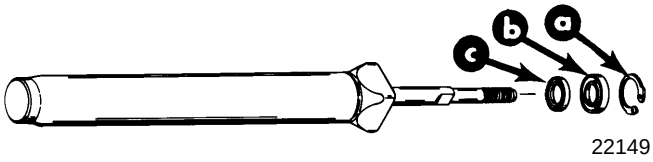
a - Cotter Pin
b - Retaining Pins (2)
c - Booster Cylinder
d - Adaptor Block Assembly

6. Remove lines from booster cylinder.



a - Metal Lines

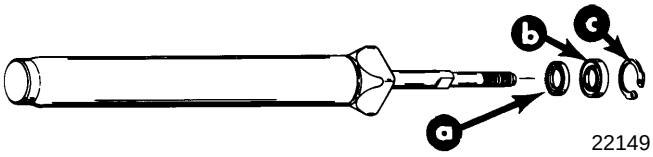
7. Remove components shown.



a - Snap Ring
b - Large Oil Seal
c - Small Oil Seal

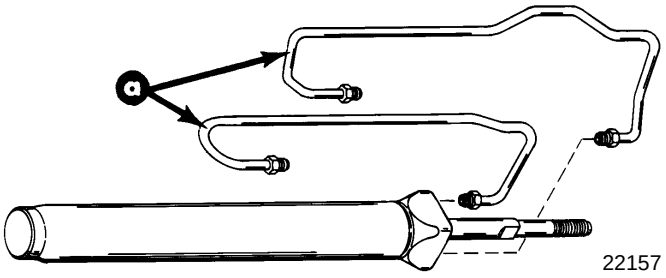
INSTALLATION

1. Install components shown.



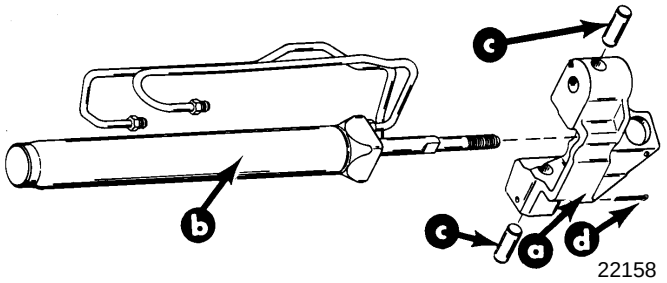
a - Small Oil Seal-Lip In
b - Large Oil Seal-Lip Out
c - Snap Ring-Install In Groove

2. Install metal lines. Tighten securely, but DO NOT overtighten.



a - Metal Lines

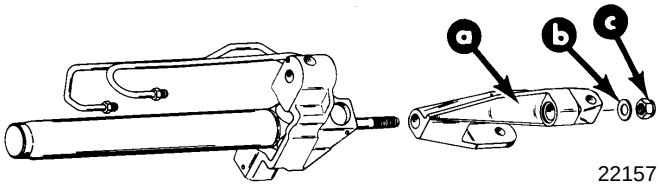
3. Install adaptor block assembly. Be sure to spread both ends of cotter pin.



22158

a - Adaptor Block Assembly
b - Booster Cylinder
c - Retaining Pins
d - Cotter Pin

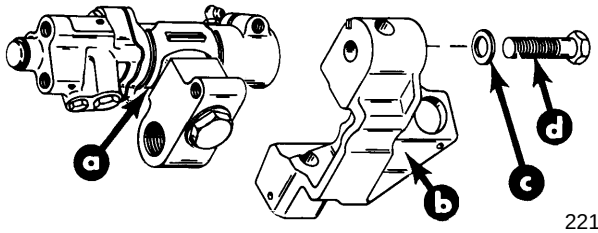
4. Install clevis assembly. Tighten nut securely.



22157

a - Clevis Assembly
b - Washer
c - Nut-Tighten Securely

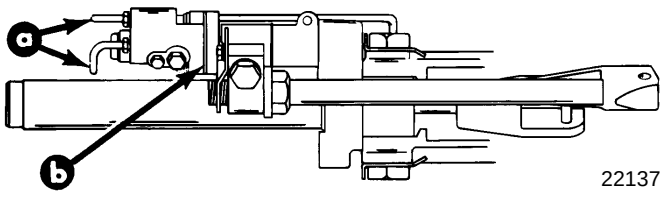
5. Secure control valve to adaptor block assembly. Torque screw to 25-35 lb. ft. (34-47 N·m).



22143

a - Control Valve
b - Adaptor Block Assembly
c - Washer
d - Screw

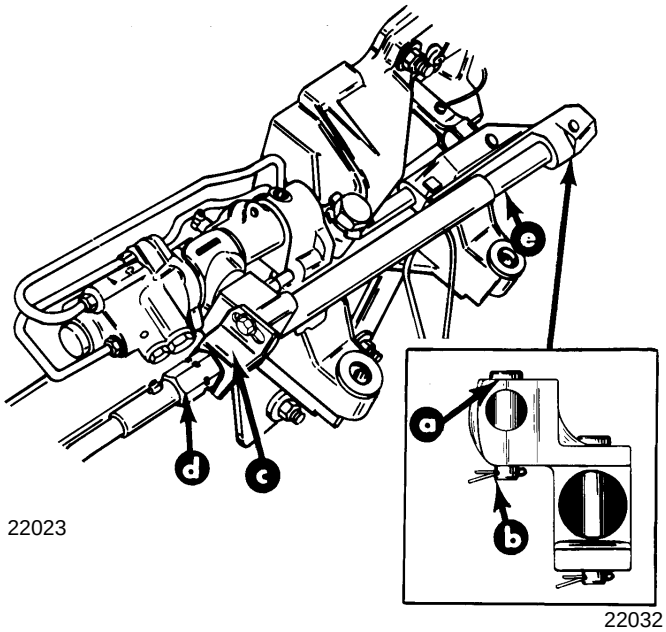
6. Install metal lines onto control valve. Tighten securely but DO NOT overtighten.



22137

a - Metal Lines
b - Control Valve

7. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
8. Torque coupler nut to 35 lb. ft. (48 N·m).
9. Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.

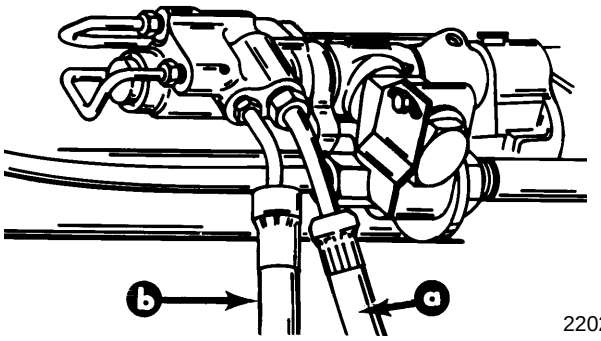


22023

22032

a - Clevis Pin
b - Cotter Pin
c - Locking Plate
d - Coupler Nut
e - Steering Cable

10. Connect power steering pump hoses to their respective fittings on control valve. Torque large fitting to 20-25 lb. ft. (27-34 N·m). Torque small fitting to 96-108 lb. in. (11-12 N·m).



22023

a - Hose (Large Fitting)
b - Hose (Small Fitting)

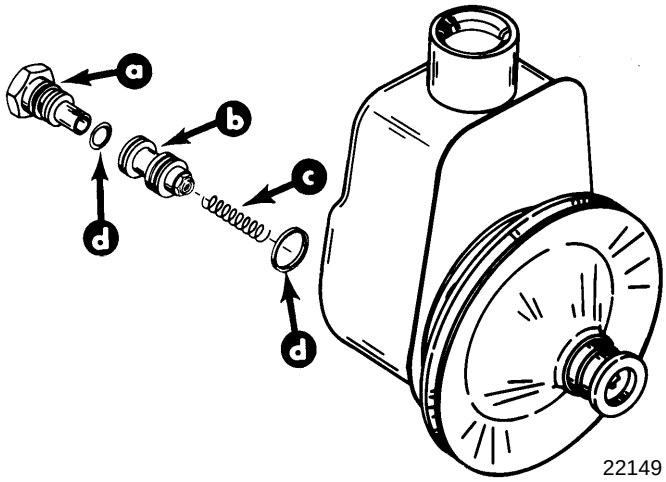
Power Steering Pump

REMOVAL

1. Disconnect hoses at pump. Cap hose and fittings.
2. Loosen pump bolts at engine to remove pump belt.
3. Remove bracket from pump.

FLOW CONTROL VALVE SERVICING

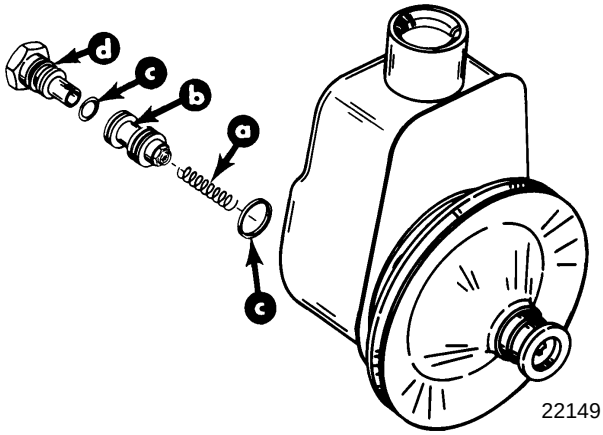
1. Drain fluid from pump.
2. Remove components shown.



22149

a - Fitting Assembly
b - Control Valve Assembly
c - Flow Control Spring
d - O-rings

3. Inspect control valve assembly and fitting assembly.
4. Install components shown. Torque fitting assembly to 35 lb. ft. (47 N·m).

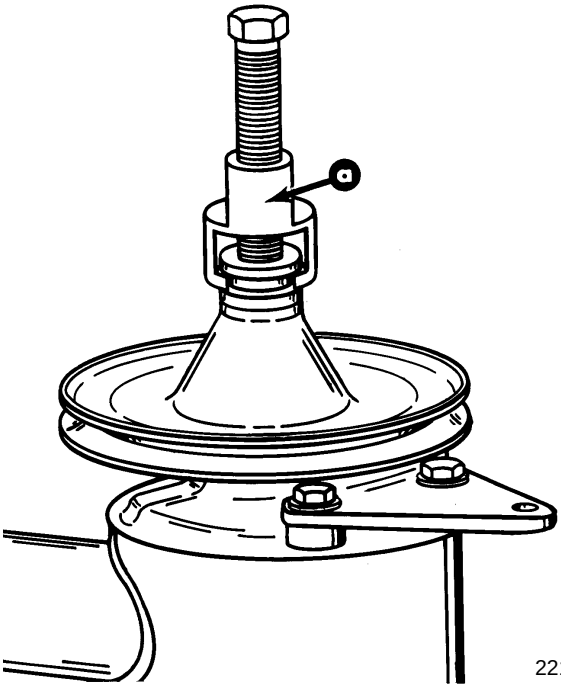


22149

a - Flow Control Spring
b - Control Valve Assembly
c - New O-rings
d - Fitting Assembly

PUMP SHAFT OIL SEAL REPLACEMENT

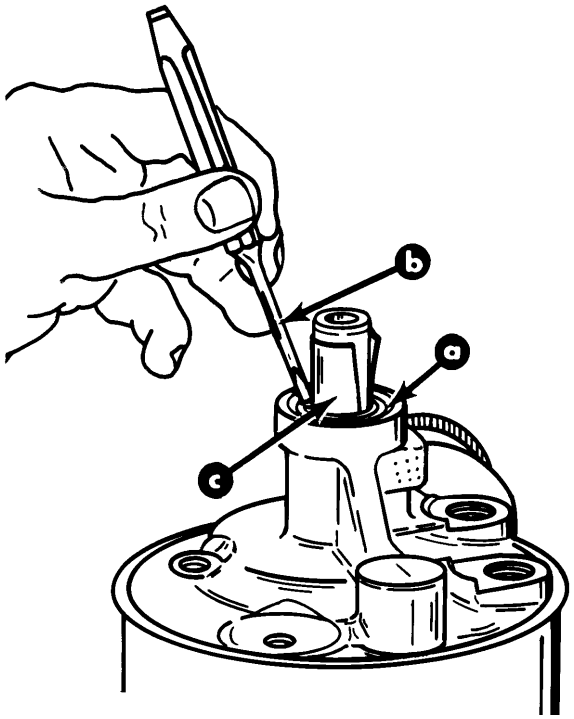
1. Remove pump pulley.



22149

a - Kent Moore Pulley Removal Tool (J-25034-C)

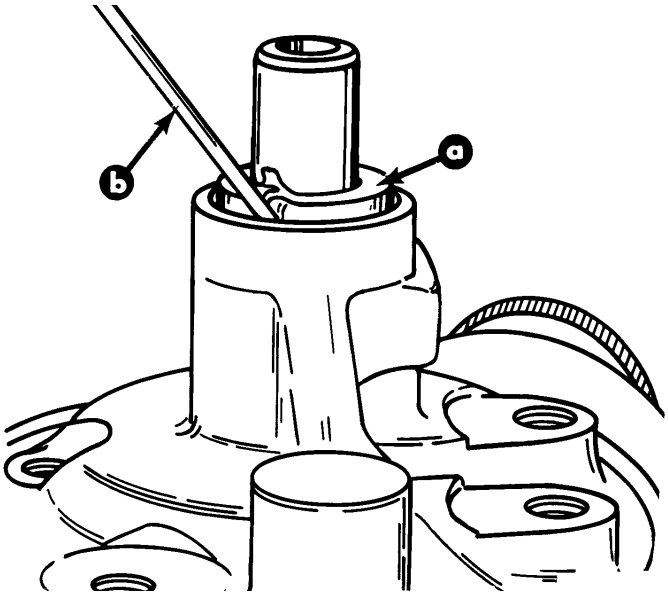
2. Push a .005 in. (0.13 mm) shim stock past oil seal until it bottoms in pump body. (Approximately 2-1/2 in. [64 mm] long)
3. Cut seal and tear metal body approximately 1 in. (25 mm).



22152

a - Oil Seal
b - Chisel-To Cut Seal
c - Shim Stock

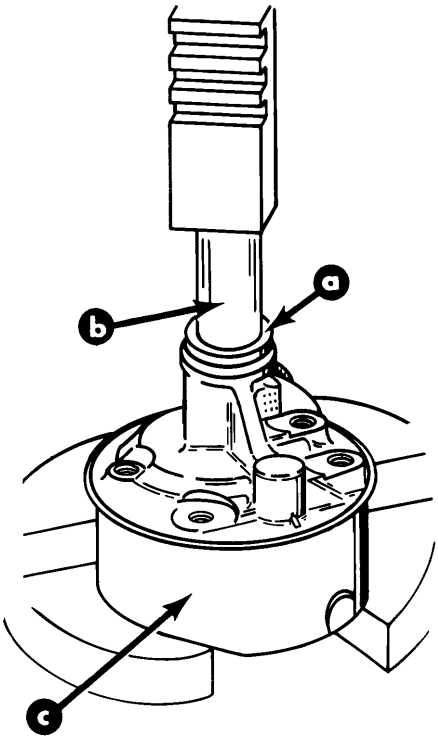
4. Remove oil seal by forcing an awl between pump housing and seal. Remove shim stock.



22152

a - Torn Seal
b - Awl

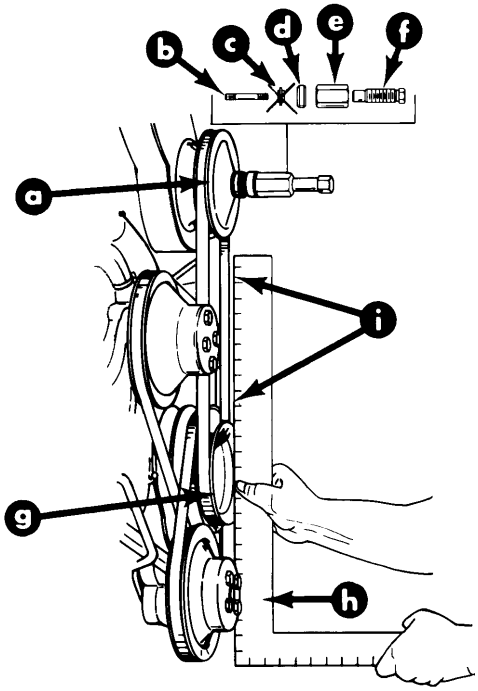
5. Install new oil seal. Properly support pump reservoir so back does not distort.



22151

a - New Oil Seal-Metal Side Up
b - 1 in. Socket
c - Pump Reservoir

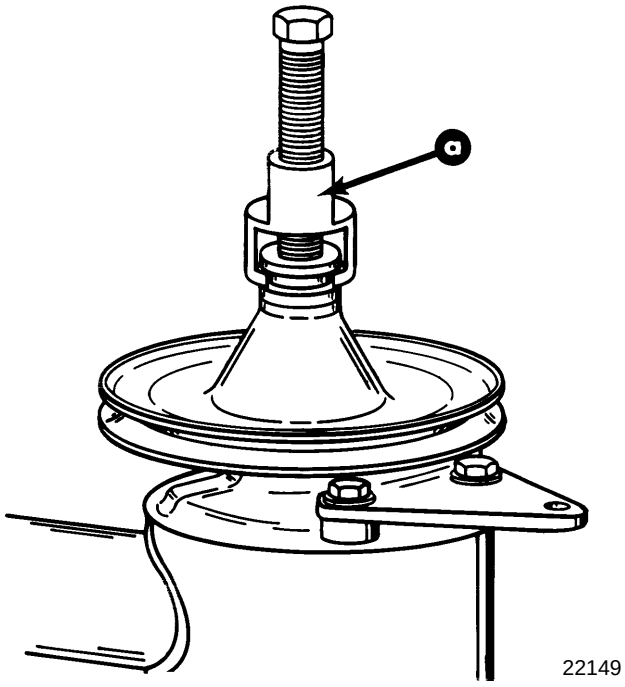
6. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
   a. Place pulley on pump shaft.
   b. Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
   c. Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
   d. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
   e. Check pulley installation for correct alignment.



a - Power Steering Pump Pulley
b - Stud
c - DO NOT Use Spacer
d - Bearing
e - Nut
f - Shaft
g - Crankshaft Pulley (Shown) Or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

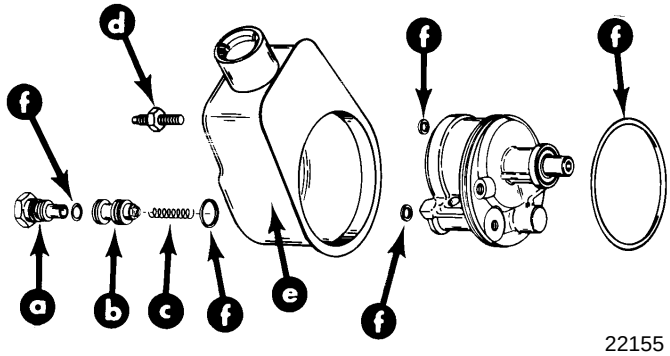
DISASSEMBLY

1. Drain fluid from pump.
2. Remove pump pulley.



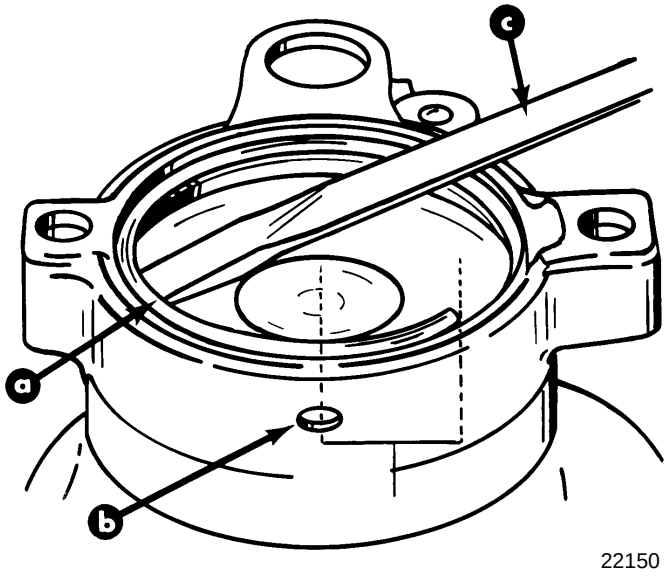
a - Kent Moore Pulley Removal Tool (J-25034)

3. Remove fitting assembly, control valve assembly, flow control spring, o-ring and studs. Discard o-ring.
4. Remove reservoir by tapping from pump housing.
5. Remove remaining o-rings and discard.



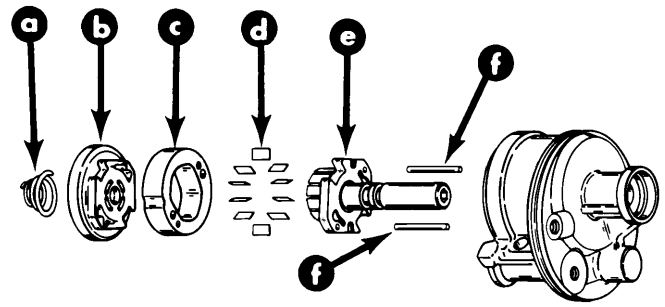
a - Fitting Assembly
b - Control Valve Assembly
c - Flow Control Spring
d - Studs
e - Reservoir
f - O-rings

6. Remove retaining ring and end plate. Insert awl into hole in housing to push ring from recess.



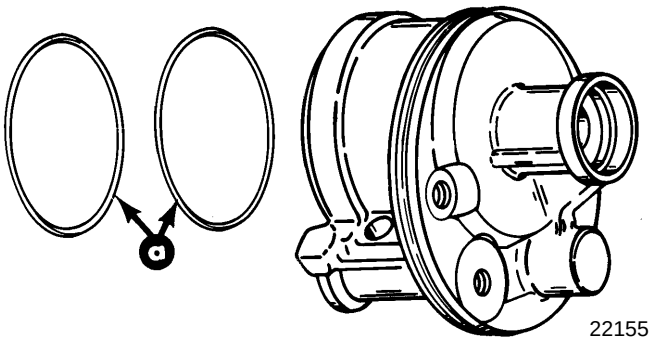
a - Retaining Ring-Position So That Ring End Is 1 in. (25 mm) From End Of Hole In Housing
b - Hole
c - Screwdriver-Pry Ring From Pump Body

7. Remove pump components shown.



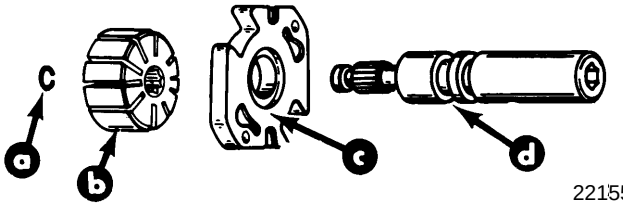
a - Spring
b - Pressure Plate
c - Pump Ring
d - Pump Vanes
e - Pump Shaft And Rotor Assembly
f - Dowel Pins

8. Remove and discard O-rings from housing.



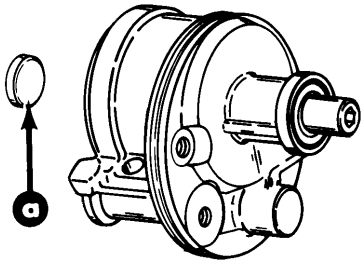
a - O-rings-Discard

9. Remove retaining ring, rotor and thrust plate.



a - Retaining Ring
b - Rotor
c - Thrust Plate
d - Pump Shaft

10. Remove magnet.



a - Magnet

CLEANING AND INSPECTION

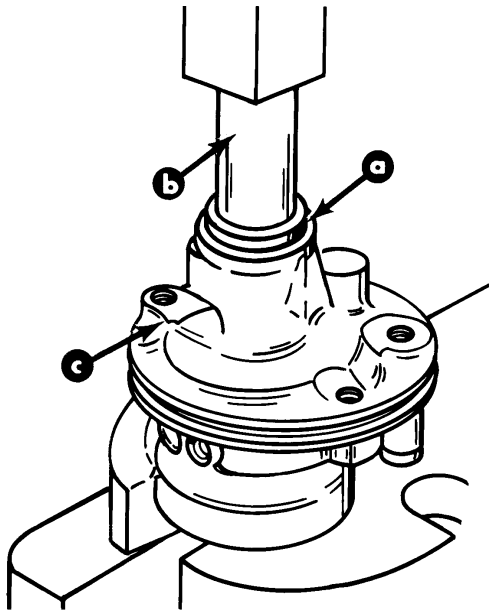
1. Clean and inspect all metal parts.

REASSEMBLY

NOTE: *All references to Power Steering fluid refer to Quicksilver Power Trim and Steering Fluid, or Dexron II if Quicksilver product is not available.*

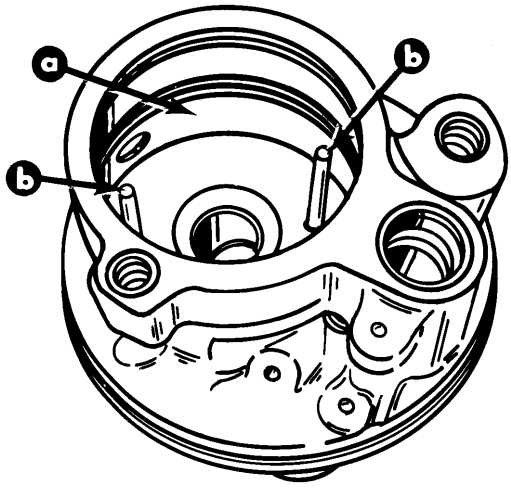
NOTE: *Obtain and install a new seal kit 5688044 from a local GM automotive dealer when reassembling pump.*

1. Install new pump shaft oil seal. Properly support pump reservoir so back does not distort.



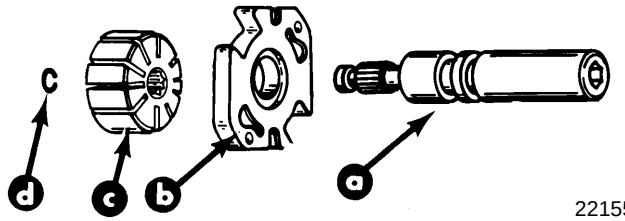
a - New Oil Seal-Metal Side Up
b - 1 in. Socket
c - Pump Reservoir

2. Lubricate pressure plate O-ring with power steering fluid; place in third groove in housing. Install dowel pins.



a - Pressure Plate O-ring
b - Dowel Pins

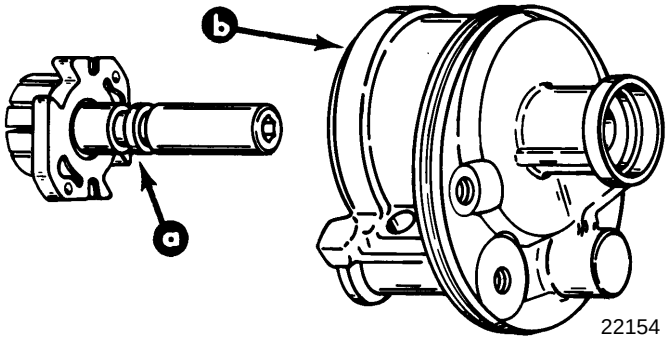
3. Assemble pump shaft and rotor assembly.



22155

a - Pump Shaft
b - Thrust Plate
c - Rotor-Countersunk Side Toward Thrust Plate
d - Retaining Ring

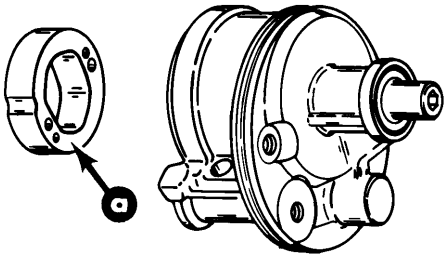
4. Install pump shaft and rotor assembly.



22154

a - Pump Shaft And Rotor Assembly
b - Pump Housing

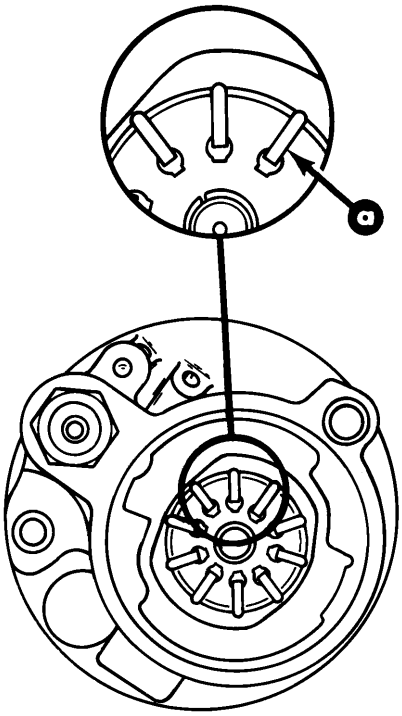
5. Install pump ring by placing two smaller holes over dowel pins.



22154

a - Pump Ring

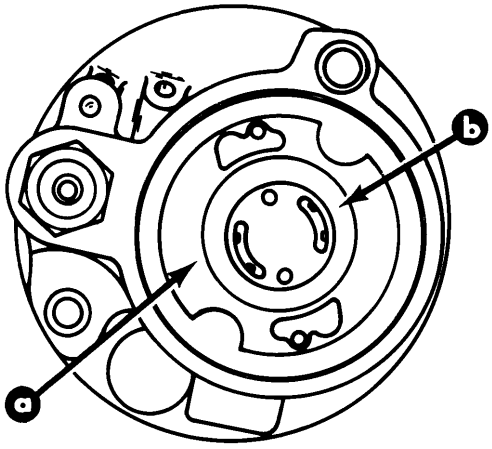
6. Install vanes in rotor slots-Rounded edges toward pump ring. Vanes must slide freely.



22154

a - Vanes-Rounded Edges Toward Pump Ring

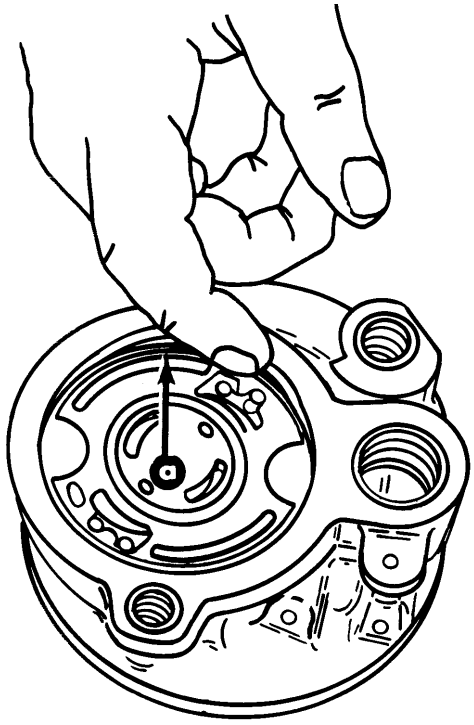
7. Install pressure plate.



22154

a - Pressure Plate
b - Spring Groove-Facing Up

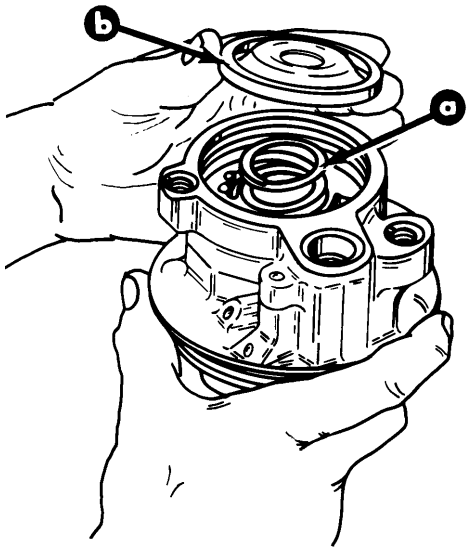
8. Lubricate end plate O-ring with power steering fluid and place in second groove in housing.



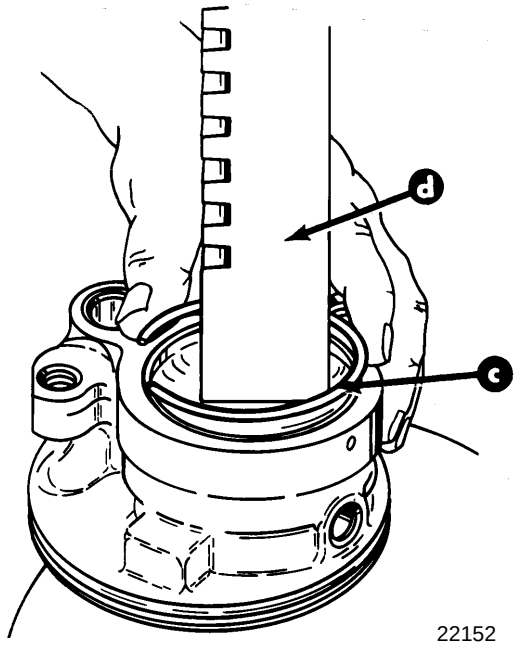
22150

a - End Plate O-ring

9. Install pressure plate spring, end plate and retaining ring.



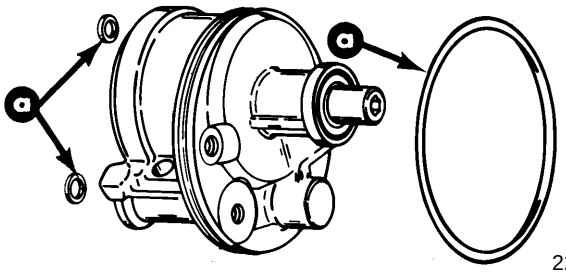
a - Pressure Plate Spring
b - End Plate



22152

c - Retaining Ring
d - Arbor Press-Use Care Not To Damage End Plate O-ring

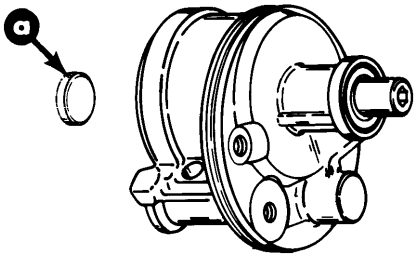
10. Lubricate reservoir O-rings with power steering fluid and install in grooves in housing.



22153

a - Reservoir O-rings

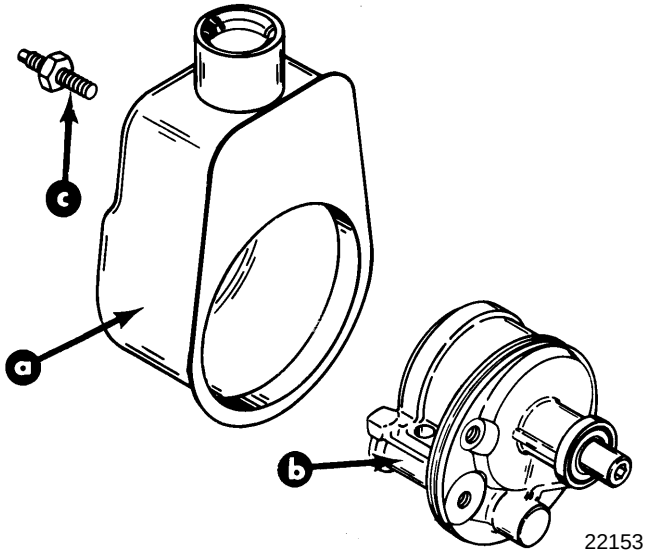
11. Place magnet on housing.



22153

a - Magnet

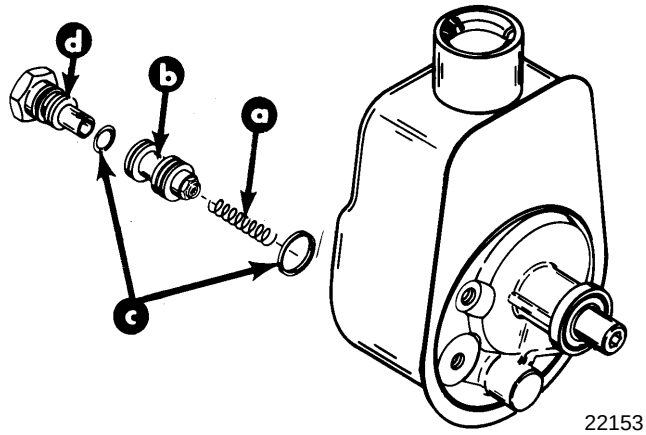
12. Secure reservoir to pump housing. Torque studs to 35 lb. ft. (47 N·m).



22153

a - Reservoir
b - Pump Housing
c - Studs

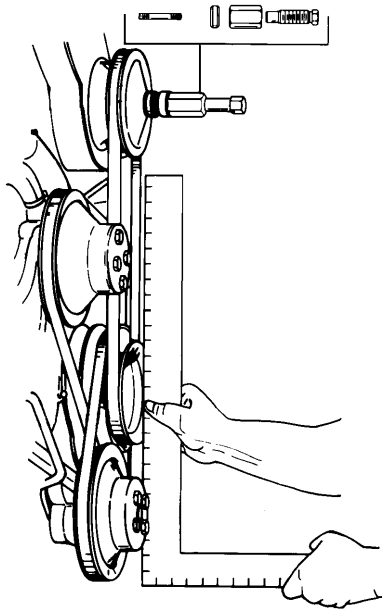
13. Install flow control spring, control valve assembly, o-rings and fitting assembly into reservoir. Torque fitting assembly to 35 lb. ft. (47 N·m).



22153

a - Flow Control Spring
b - Control Valve Assembly
c - O-ring-For Fitting Assembly
d - Fitting Assembly

14. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
    a. Place pulley on pump shaft.
    b. Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
    c. Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
    d. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
    e. Check pulley installation for correct alignment.



75753

a - Power Steering Pump Pulley
b - Stud
c - DO NOT Use Spacer
d - Bearing
e - Nut
f - Shaft
g - Crankshaft Pulley (Shown) Or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

INSTALLATION

1. Install power steering pump on engine. (Refer to Appropriate Engine Service Manual)

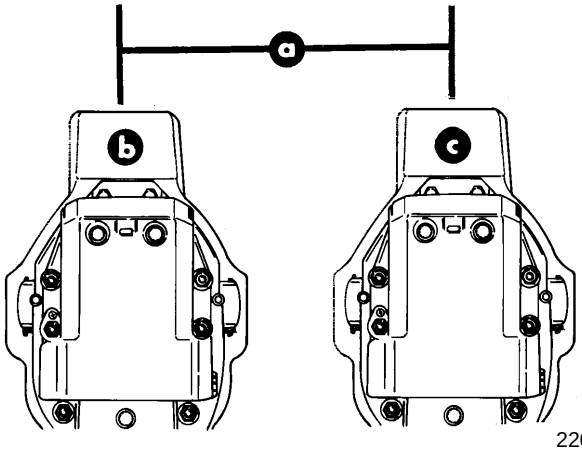
Determining Tie Bar Length

⚠WARNING

ON DUAL INSTALLATION USING STARBOARD TIE BAR KIT. The steering cable MUST have a minimum radius of 8 in. (203 mm) at the transom end. A radius less than 8 in. (203 mm) may kink the steering cable which, in turn, may affect steering operation. If the minimum 8 in. (203 mm) requirement cannot be met due to boat construction, etc., steering cable must then be routed to port transom and a port transom and a port tie bar kit 96708A4, A5 or A6 MUST BE used in place of the starboard tie bar kit.

NOTE: *If drive units are to be "toed-in" or "toed-out", measure from centerlines of steering levers (with drive units positioned as desired), instead of centerlines of power packages. In most cases, the best boat handling and performance characteristics will be obtained with the drive units positioned parallel.*

1. Determine tie bar length.
   a. Measure centerline distance (a) from points (b) and (c). (Grease Fittings on Gimbal Housing)
   b. Apply measurement to appropriate chart to determine tie bar length.



22031

Selection

TIE BAR CHART For Dual Installations with Steering Cable Attached to Starboard Power Package	
* 16" to 30" * 30" to 46" 46" to 62"	92020A1 92020A2 92020A3
*If centerline distance is the same as maximum figure, use next larger size tie-bar.	

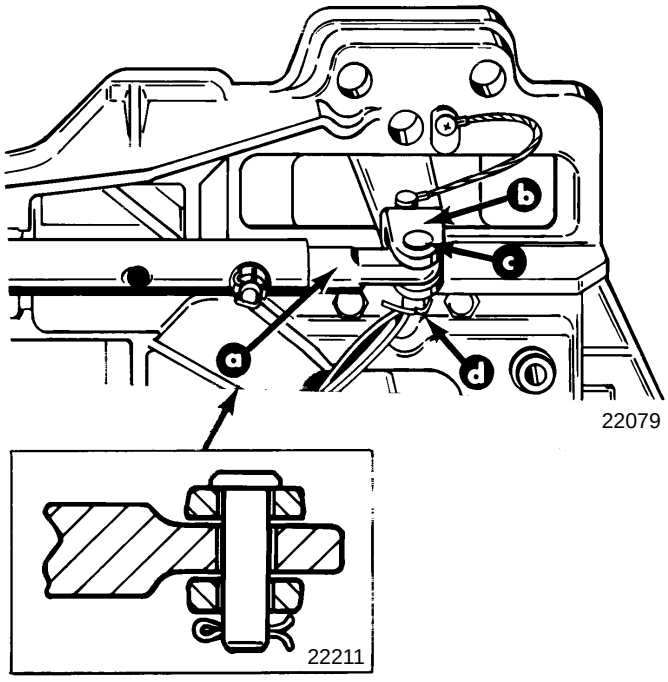
TIE BAR CHART For Dual Installations with Steering Cable Attached to Port Power Package	
Distance Between Engine Centerlines	Tie Bar Required
* 28" to 37-1/2" * 37-1/2" to 55" 55" to 72"	96708A4 96708A4 96708A6
*If centerline distance is the same as maximum figure, use next larger size tie-bar.	

Installation

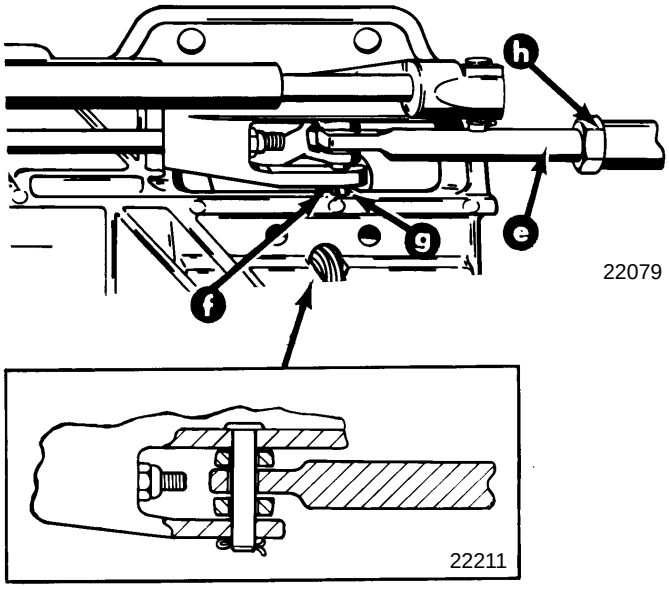
DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO STARBOARD POWER PACKAGE

1. Install tie bar.

   a. Attach fixed bar end (a) to steering lever (b), using clevis pin (c) and cotter pin (d). Spread cotter pin ends.



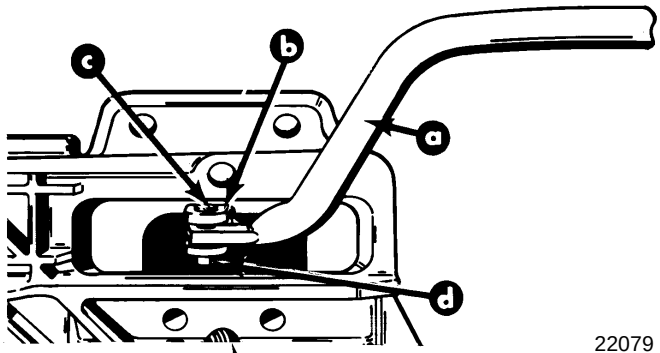
   b. Position drive units as desired and turn adjustable end (e) out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis. Turn adjustable end (e) out 3 to 4 turns from this position. Apply Loctite Type “A”, or equivalent, to exposed tie bar threads; then turn tie bar back in (3 to 4 turns) to previously aligned position. Attach tie bar end using clevis pin (f), and cotter pin (g). Spread cotter pin ends. Apply Loctite Type “A”, or equivalent, to exposed tie bar threads, then, tighten locknut (h) (against tie bar) to 40-60 lb. ft. (54-81 N·m).



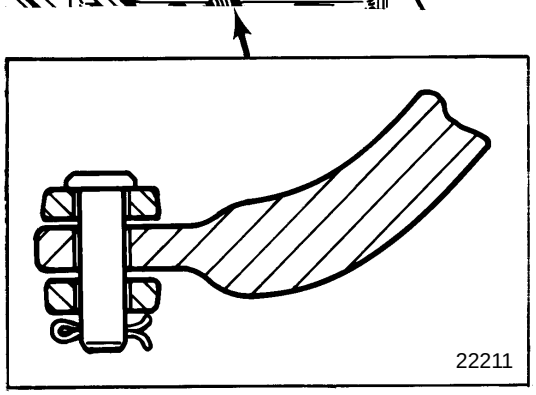
DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO PORT POWER PACKAGE

1. Install tie bar.

   a. Attach fixed bar end (a) to steering lever (b), using clevis pin (c) and cotter pin (d). Spread cotter pin ends.

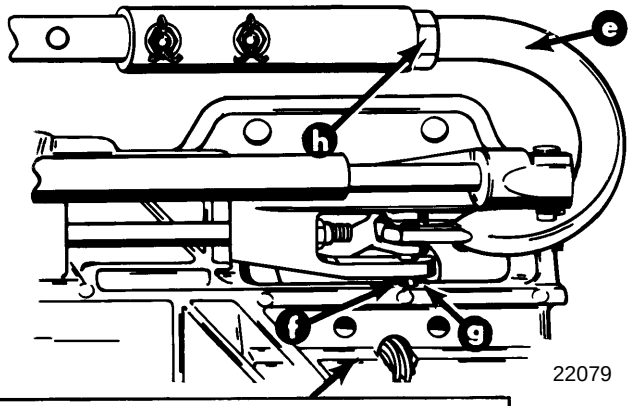


22079

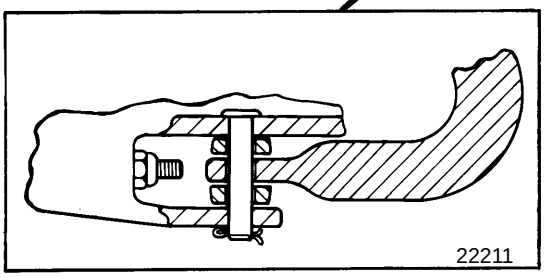


22211

   b. Position drive units as desired and turn adjustable end (e) out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis. Turn adjustable end (e) out 3 to 4 turns from this position. Apply Loctite Type “A”, or equivalent, to exposed tie bar threads; then turn tie bar back in (3 to 4 turns) to previously aligned position. Attach tie bar end using clevis pin (f), and cotter pin (g). Spread cotter pin ends. Apply Loctite Type “A”, or equivalent, to exposed tie bar threads, then, tighten locknut (h) (against tie bar) to 40-60 lb. ft. (54-81 N·m).

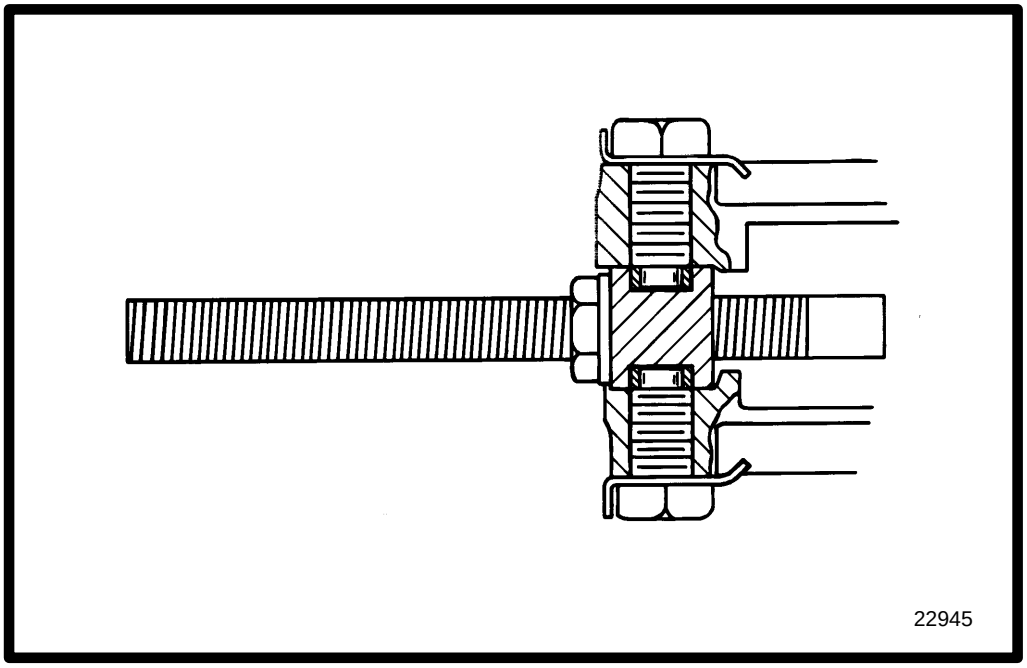


22079



22211

STEERING SYSTEM



6
B

MANUAL STEERING

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Specifications

Torque Specifications

DESCRIPTION	TORQUE		
	lb. in.	lb. ft.	N·m
Steering Cable Coupler Nut		35	48
Steering System Pivot Bolt		25	34
Steering Tube Nut		35-40	47-54

Lubricants/Sealers/ Adhesives

Description	Part No.
2-4-C Marine Lubricant with Lubricant	92-825407A12
Special Lubricant 101	92-13872A1
Locquic Primer T	92-59327-1
Loctite No. 35	92-59328-1

Steering Cable Selection, Removal, and Installation

Selection

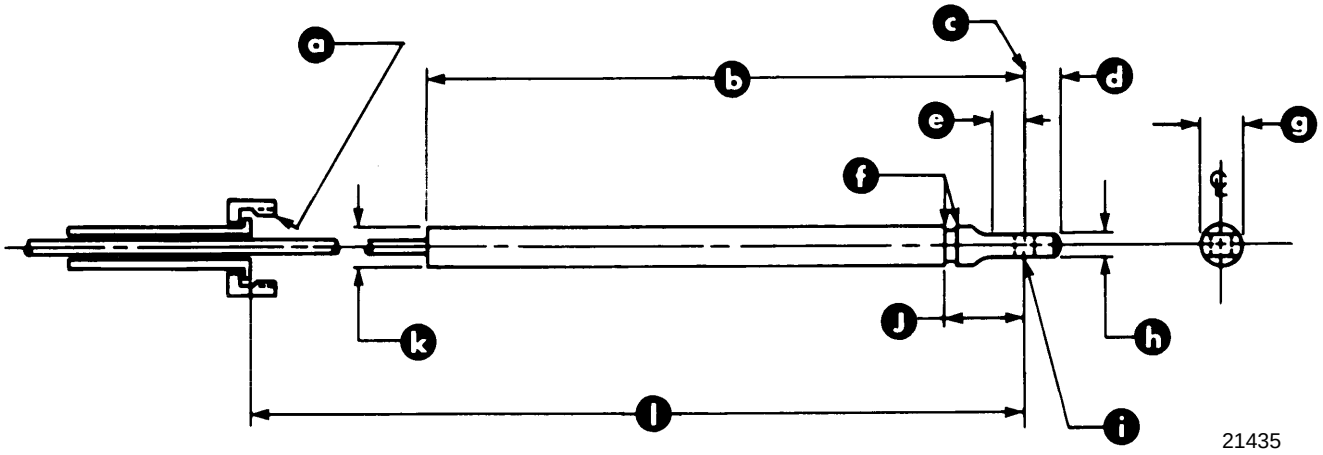
Steering system has the steering cable guide tube set for cables with end dimensions which comply with the BIA Certification Handbook.

⚠CAUTION

If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result.

⚠CAUTION

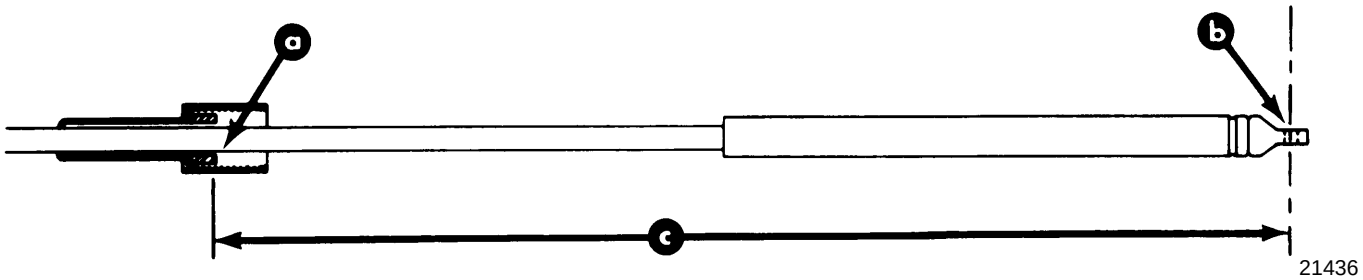
Steering cables MUST BE THE CORRECT LENGTH, particularly when installed in large boats. Sharp bends or too-short cables result in kinks; too-long cables require unnecessary bends and/or loops. Both place an extra stress on the cable. The proper cable is as short as possible, with the fewest bends and with radii as large as possible.



21435

Steering Cable Dimension

a - Coupler Nut - 7/8 - 14 UNF - 2B Thread
b - 11-3/4 in. (298.45 mm) Min.
c - Interface Point
d - 1/2 in. (12.7 mm) Max.
e - 420 in. (10.668 mm) Min. Flat
f - 02 in. (.508 mm) Min. Radius
g - 5/8 in. (15.875 mm) Max. Diameter End Fitting
h - 3/8 in. (9.525 mm)
i - .385 in. (9.779 mm) Diameter Thru Hole, Chamfered Each Side
j - 1-3/8 in. (34.925 mm) Max.
k - 5/8 in. (15.875 mm) Diameter Tube
l - Mid Travel Position - 16-7/8 in. (429 mm). Total Travel To Be 8 in.(203 mm) Min., To 9 in. (229 mm) Max. Travel Each Side Of Mid-Travel Position - 4 in. (102 mm) Min. To 4-1/2 in. (114 mm) Max.

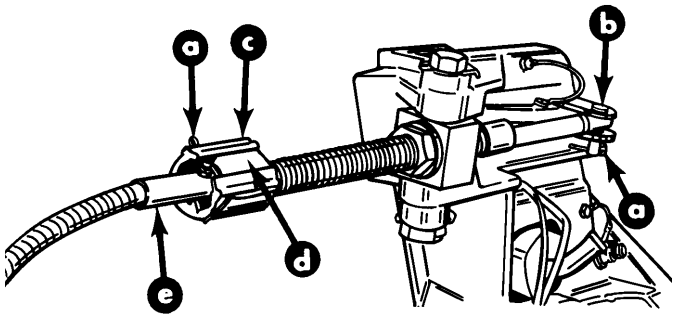


21436

a - Steering Cable Mounting Flange
b - Center Of Hole In Steering Cable End
c - 21-3/8 in. (543 mm) Maximum

Removal

1. Remove cotter pin, clevis pin and locking sleeve. Unthread the cable coupler nut and remove steering cable.



22055

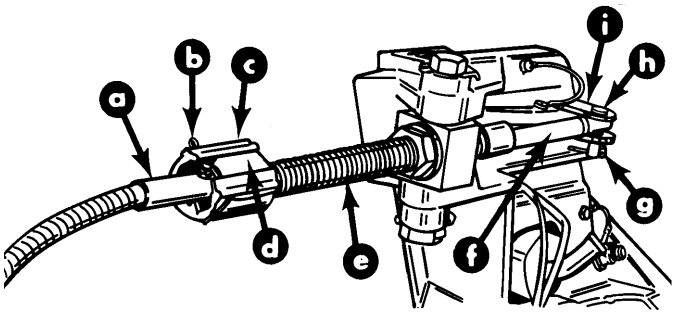
a - Cotter Pin
b - Clevis Pin
c - Locking Sleeve
d - Cable Coupler Nut
e - Steering Cable

Installation

1. Liberally coat steering cable end with a liberal amount of Special Lubricant 101 and install cable. Be sure to spread both ends of the cotter pin. Torque cable coupler nut to 35 lb. ft. (48 N·m).

⚠WARNING

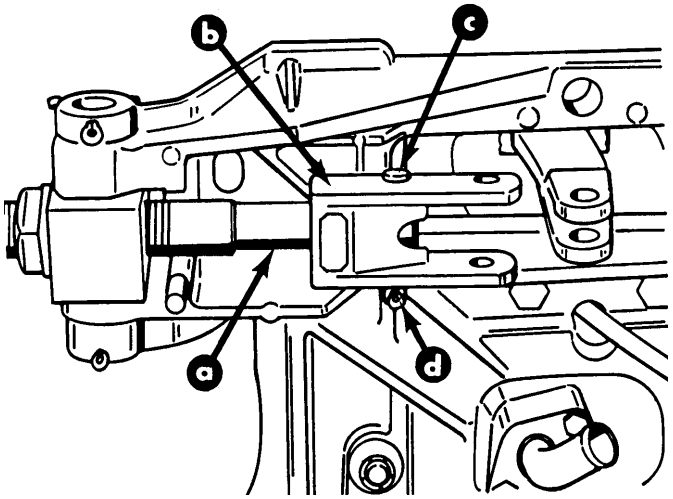
Steering cable outer casing MUST BE free to move back and forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.



22055

a - Steering Cable
b - Cotter Pin
c - Locking Sleeve
d - Cable Coupler Nut
e - Steering Cable Guide Tube
f - Steering Cable End
g - Cotter Pin
h - Clevis Pin
i - Steering Lever

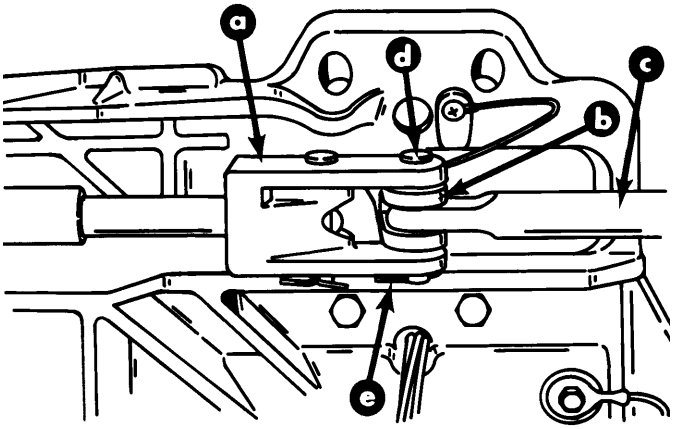
NOTE: *On dual installations only, secure clevis assembly to steering cable end.*



50478

a - Steering Cable End
b - Clevis Assembly
c - Clevis Pin
d - Cotter Pin

2. Connect clevis to steering lever and tie bar.



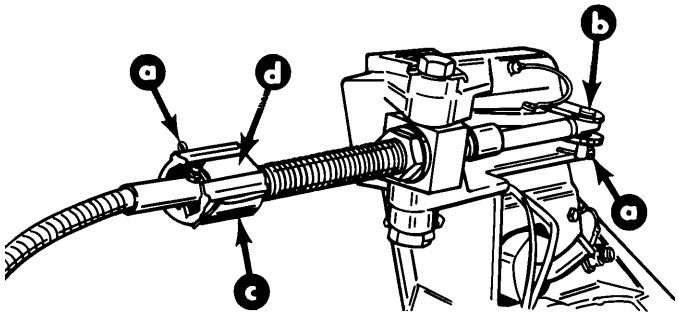
50483

a - Clevis Assembly
b - Steering Lever
c - Tie Bar
d - Clevis Pin
e - Cotter Pin

Manual Steering Swivel Ring Component Repair

Removal

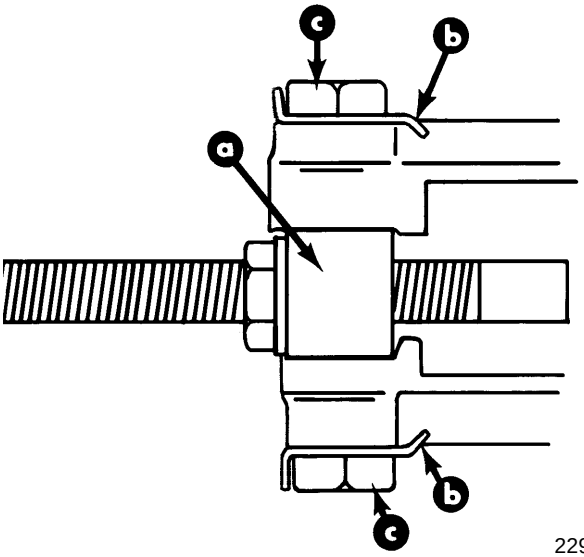
1. Remove steering cable.



22055

a - Cotter Pins
b - Clevis Pin
c - Locking Sleeve
d - Cable Coupler Nut

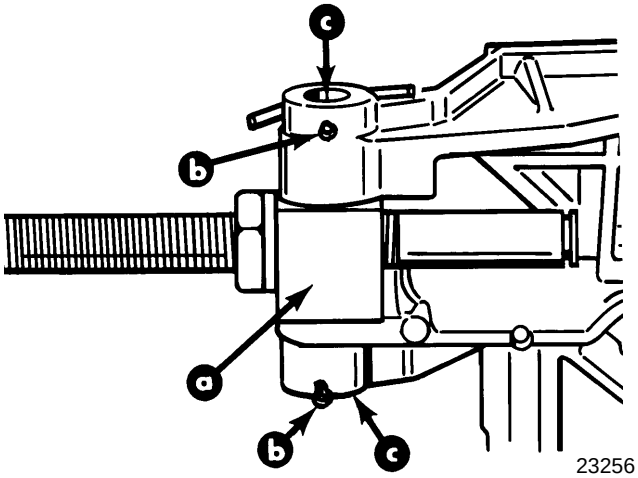
2. Remove manual steering swivel ring. Be sure to bend tab on tab washer away from pivot bolt before removing.



22945

Steering Units Secured with Pivot Bolts

a - Swivel Ring
b - Tab Washer
c - Pivot Bolt



23256

Steering Units Secured with Pivot Pins

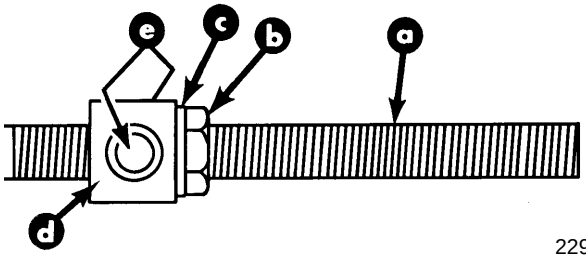
a - Swivel Ring
b - Cotter Pins
c - Pivot Pins

Disassembly

⚠CAUTION

DO NOT apply source of heat (i.e.-heat lamp, etc.) directly to swivel ring bushings, as damage to bushing may result.

1. Remove components shown. It may be necessary to apply heat to loosen loctite on nut.



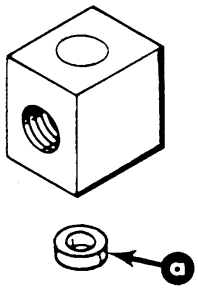
22946

Manual Steering Swivel Ring Components

a - Guide Tube
b - Nut
c - Washer
d - Swivel Ring
e - Bushings

Reassembly

1. Install bushings by pressing into swivel ring.

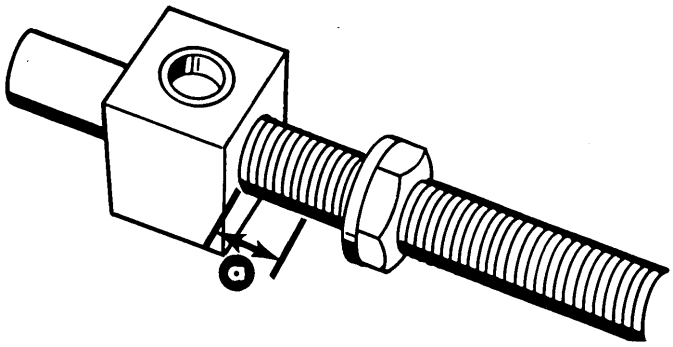


a - Bushings

⚠WARNING

Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

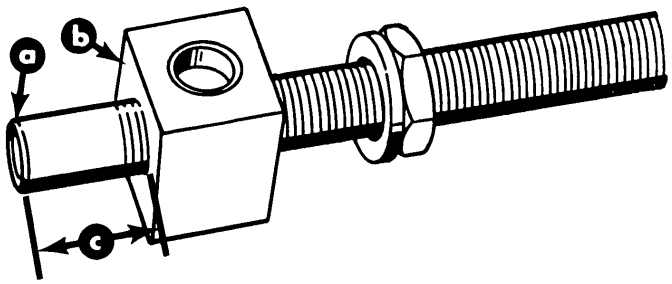
2. Clean guide tube threads with a wire brush to remove old Loctite. Spray threads with Locquic Primer “T”. After primer has dried (approximately 10 minutes), apply a liberal amount of Loctite No. 35 to guide tube threads (in area where swivel ring and locknut will be installed).



50478

a - Apply Locquic Primer “T” Here

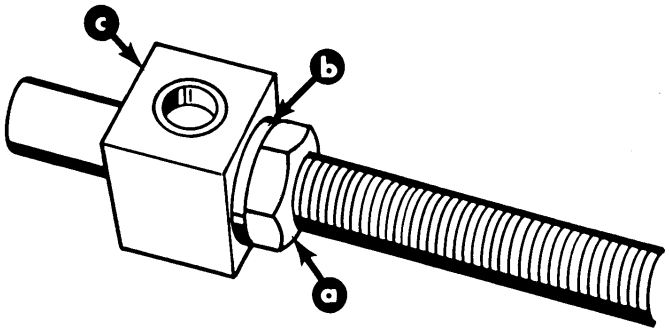
3. Turn swivel ring to obtain dimension shown.



50478

a - Cable Guide Tube
b - Swivel Ring
c - 2-1/2 in. ± 1/8 in. (64 mm ± 3 mm)

4. Tighten nut and washer against swivel ring. Torque nut to 35 - 40 lb. ft. (47 - 54 N·m).



50478

a - Nut - Torque To 35 - 40 lb. ft. (47 - 54 N·m)
b - Washer
c - Swivel Ring

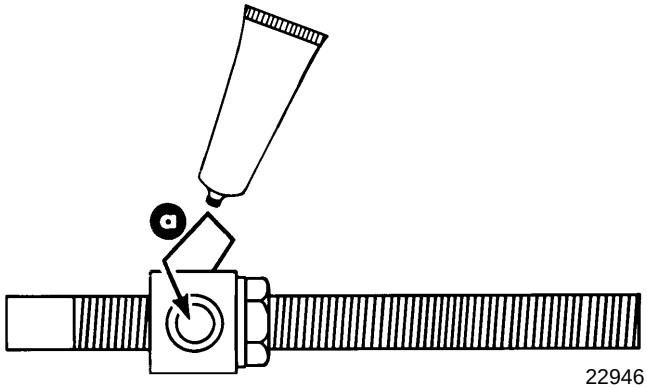
Installation

Manual steering swivel rings secured with pivot bolts, follow method “a”.

Manual steering swivel rings secured with pivot pins, follow method “b”.

METHOD “A”

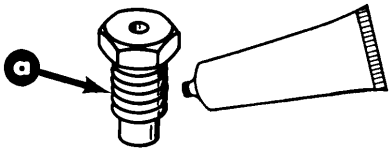
1. Lubricate swivel ring bushings with Special Lubricant 101.



22946

a - Bushings

2. Lubricate pivot bolts with Special Lubricant 101.

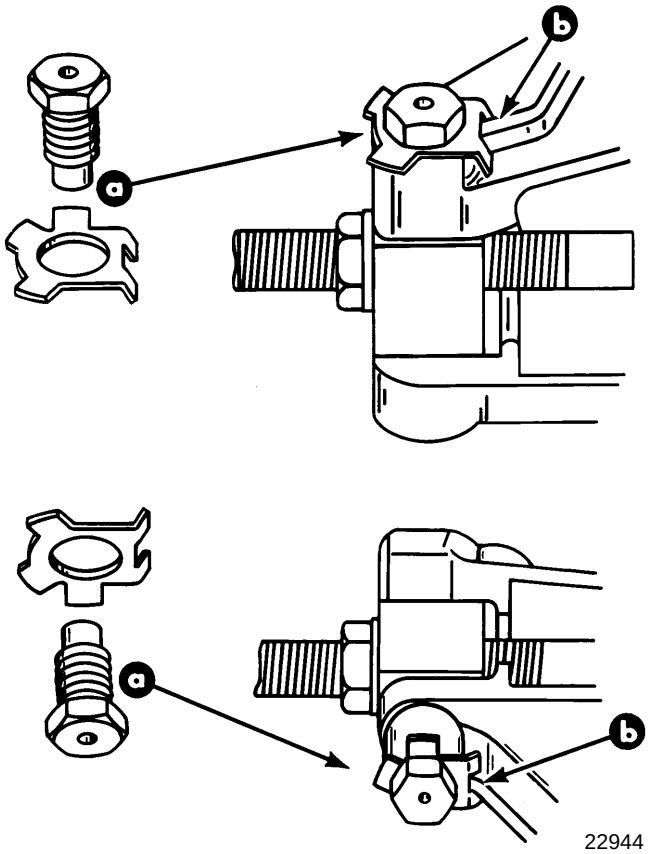


22944

a - Pivot Bolts

Index

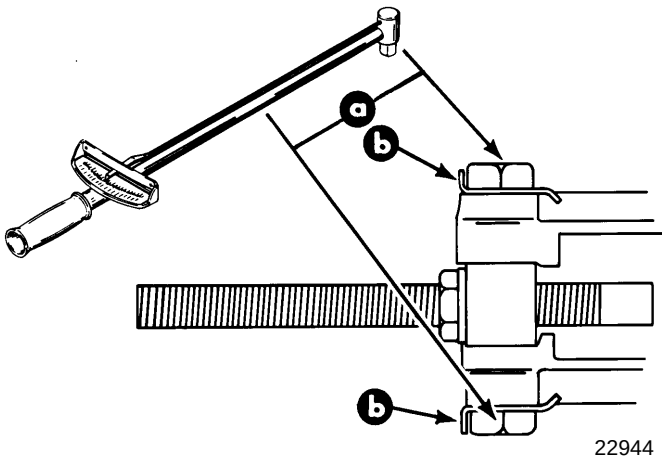
3. HAND THREAD pivot bolts all the way into inner transom plate and swivel ring. DO NOT use a wrench. Straddle tab washer tangs on inner transom plate ridge.



22944

a - Pivot Bolts
b - Tab Washer
c - Swivel Ring

4. Torque bolts to 25 lb. ft. (35 N·m). Bend washer tabs against corresponding flats on bolt tabs.



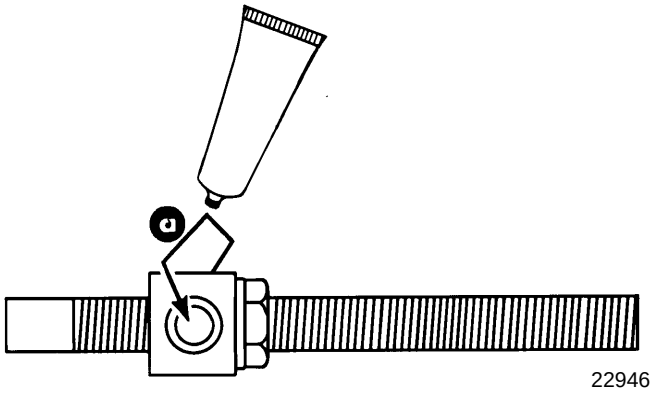
22944

a - Pivot Bolts
b - Washer Tabs

5. Move swivel ring back-and-forth to ensure that it pivots freely.

Method "B"

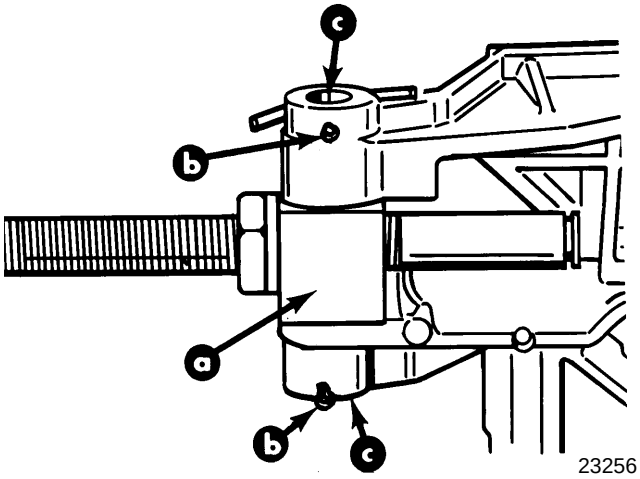
1. Lubricate swivel ring bushings and retaining pins with Special Lubricant 101.



22946

a - Bushings

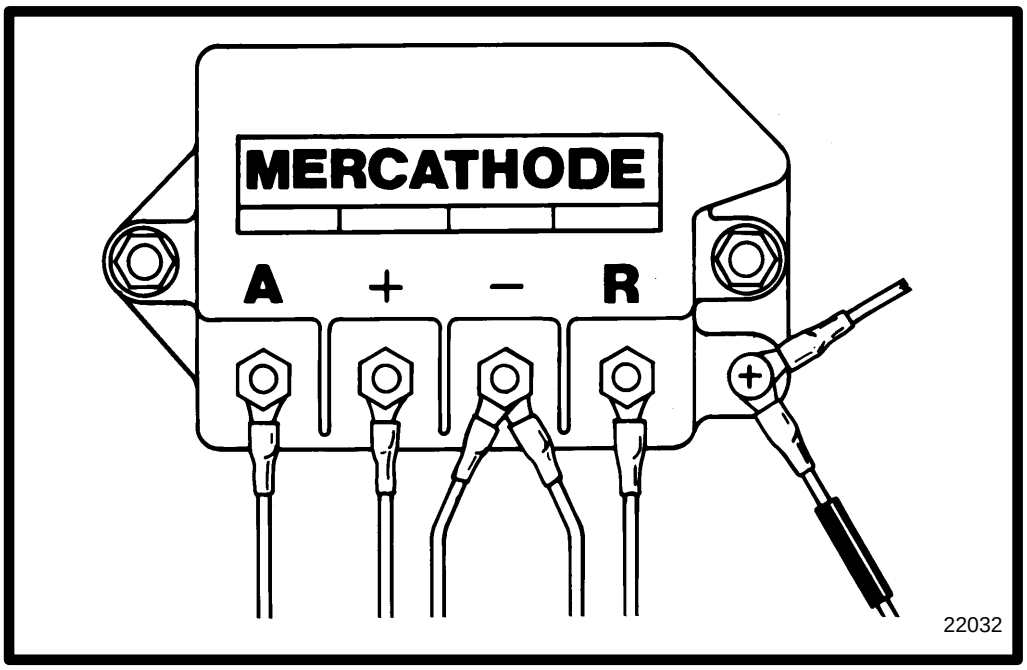
2. Install swivel ring. Be sure to spread both ends of both cotter pins.



23256

a - Swivel Ring
b - Cotter Pins
c - Pivot Pins (Hidden)

CORROSION PROTECTION



7
A

ALL MODELS

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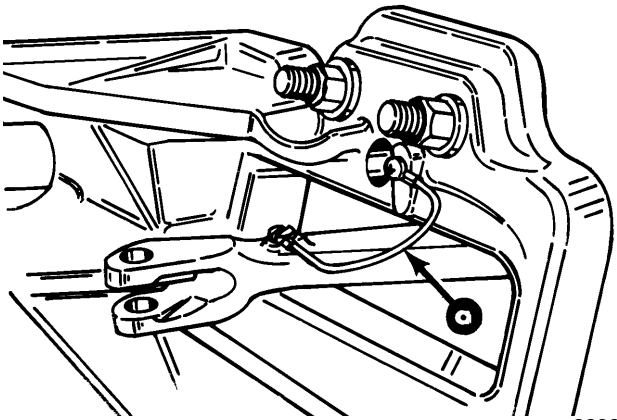
Continuity Circuit

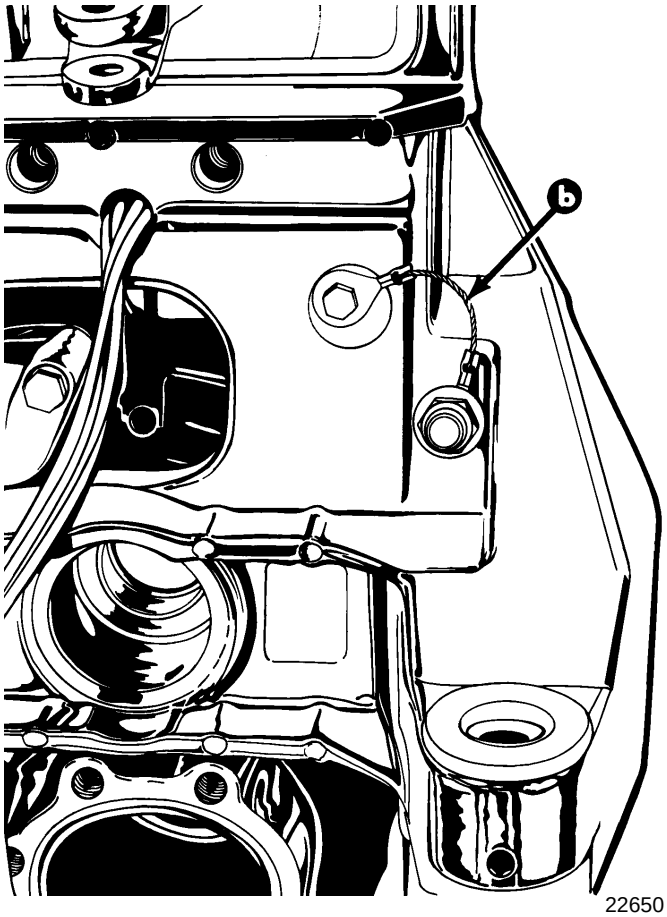
Transom assembly and sterndrive unit are equipped with a continuity circuit, to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the zinc trim tab and MerCathode System to function most effectively.

Inspect the following continuity circuit components, at intervals (Section 1B) for loose connections or broken or frayed wires.



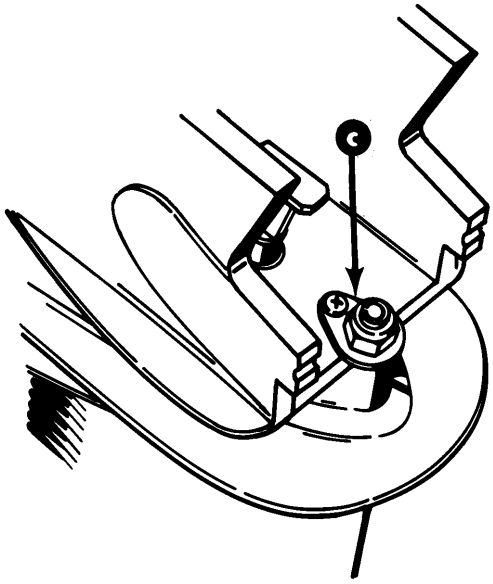
22028

a - Steering Lever Ground Wire



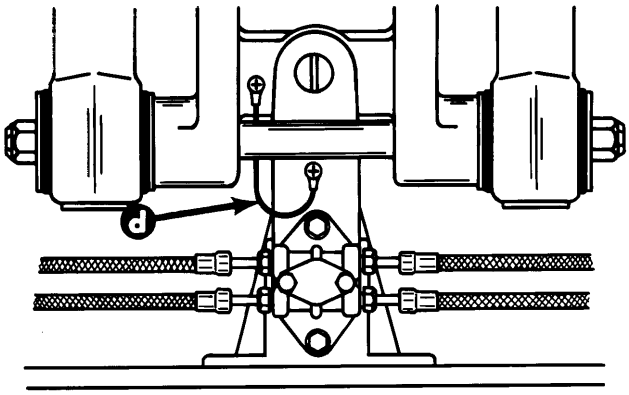
22650

b - Inner Transom Plate To Gimbal Housing Ground Wire



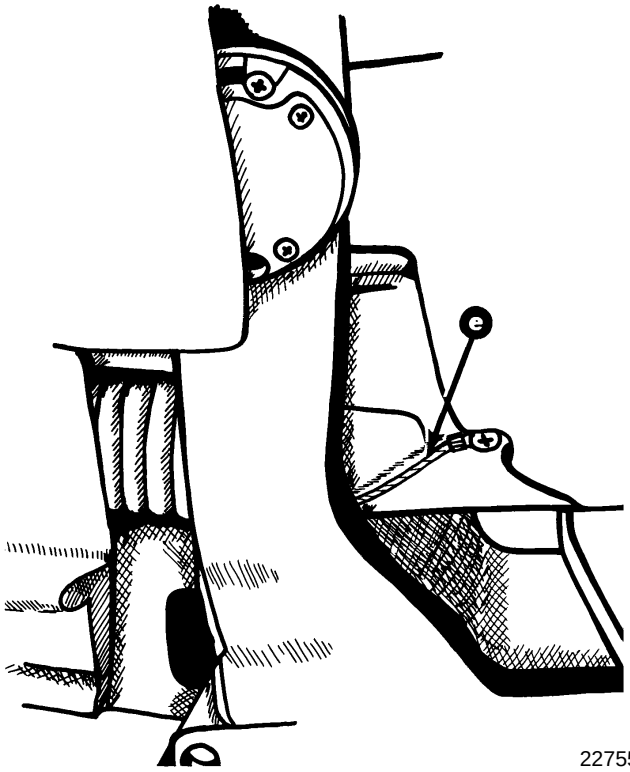
22061

c - Drive Shaft Housing To Gear Housing Ground Plate



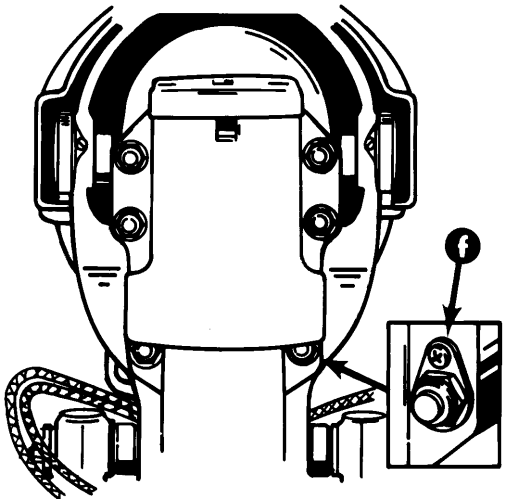
22230

d - Gimbal Housing To Gimbal Ring Ground Wire



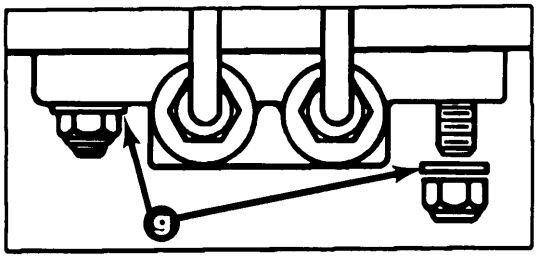
22755

e - Gimbal Ring To Bell Housing Ground Wire



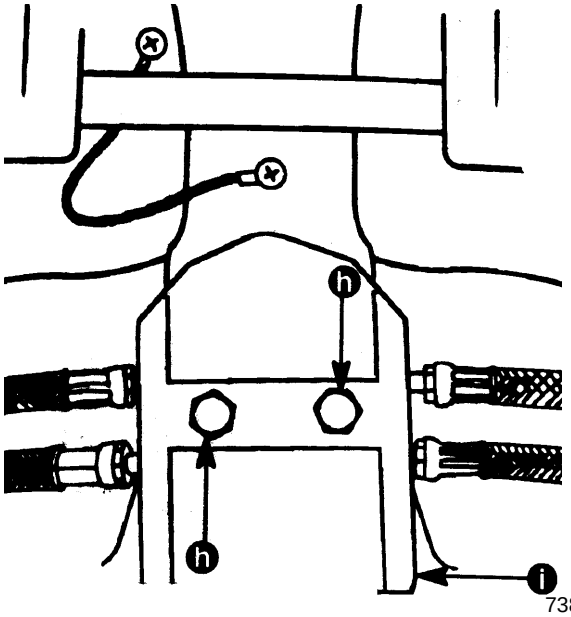
22062

f - Drive Unit To Bell Housing Ground Plate



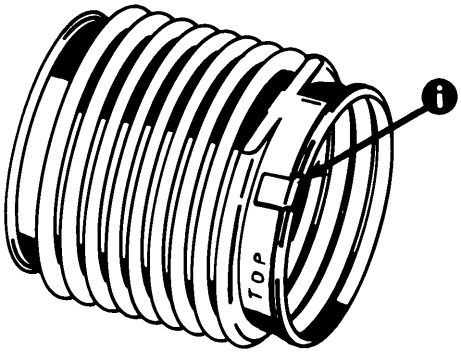
70764

g - Hydraulic Manifold Block To Gimbal Housing Continuity Washers



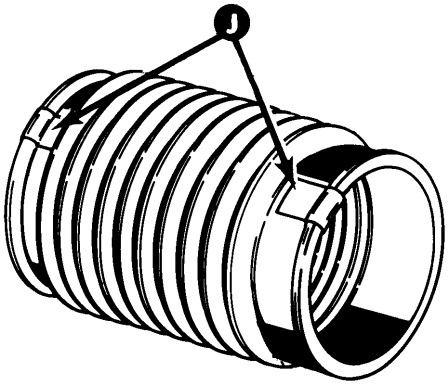
73892

h - Ground Washers (Beneath Screws)
i - Anode



50383

j - U-Joint Bellows Ground Clip



22079

k - Exhaust Bellows Ground Clip

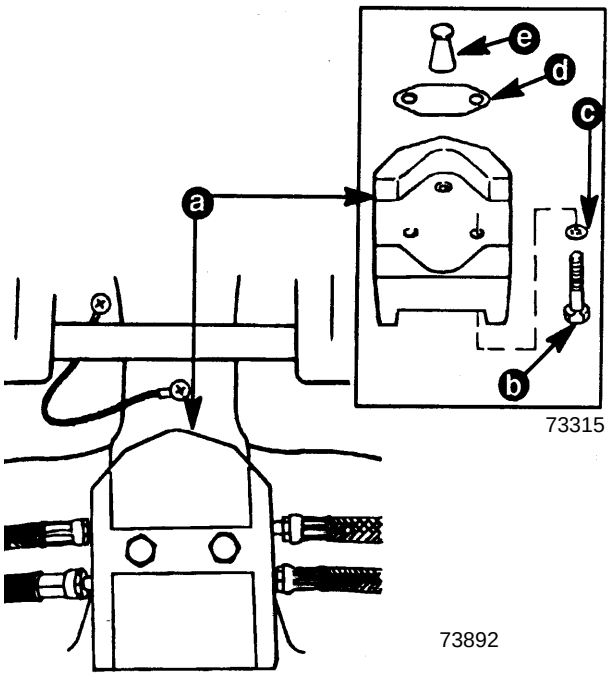
Anodic Block

Replacement

⚠CAUTION

DO NOT paint new anodic block, as this will render it ineffective as a galvanic corrosion inhibitor.

1. Remove screws, ground washers and gasket from anodic block. Remove anodic block to hydraulic manifold gasket and discard.

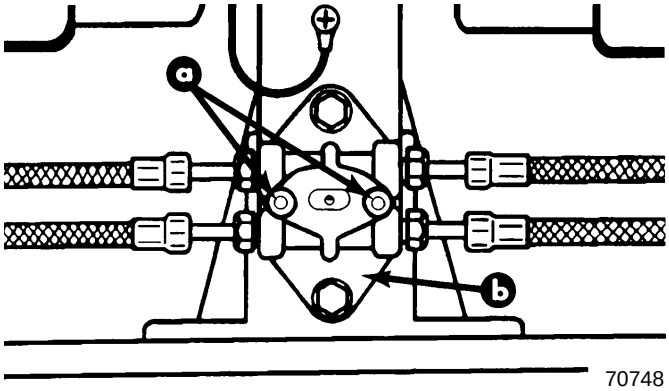


73315

73892

a - Anodic Block
b - Screws
c - Continuity Washer
d - Gasket
e - Seal

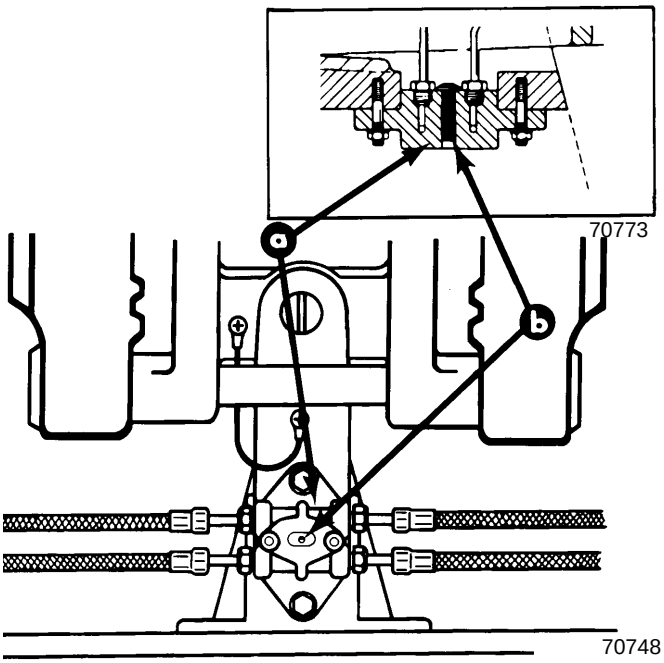
2. Check condition of hydraulic manifold and clean any debris from threaded holes.



70748

a - Screw Holes
b - Hydraulic Manifold

3. Examine rubber seal inside of hydraulic manifold block for signs of leakage or wear. Replace if necessary.

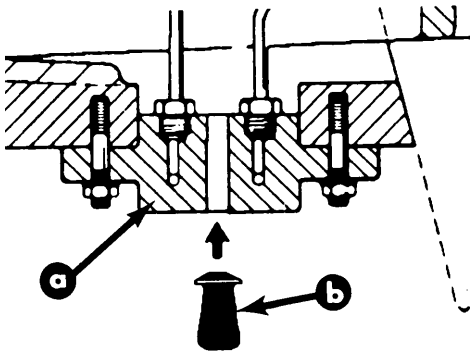


70773

70748

a - Hydraulic Manifold
b - Rubber Seal

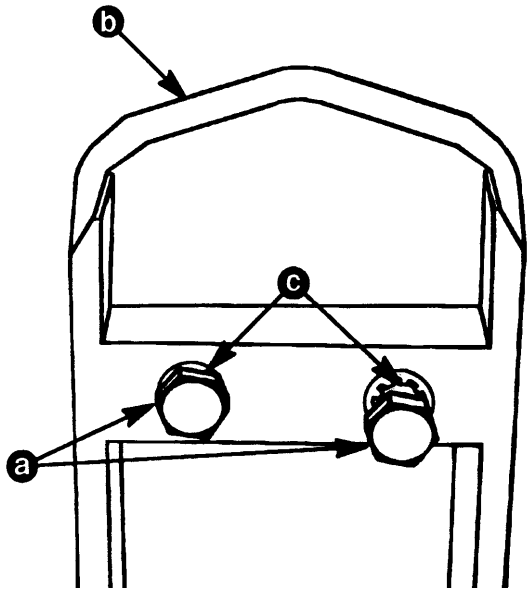
4. If rubber seal needs replacement, push old seal out of hydraulic manifold and install new seal as shown.



70774

a - Hydraulic Manifold
b - Rubber Seal

5. Install screws and washers into block as shown.



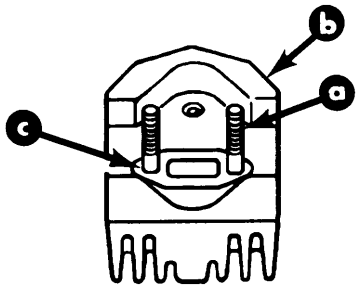
73891

a - Screws (2)
b - Anodic Block
c - Continuity Washers

⚠CAUTION

To be effective, new anodic block MUST make good continuity contact with gimbal housing.

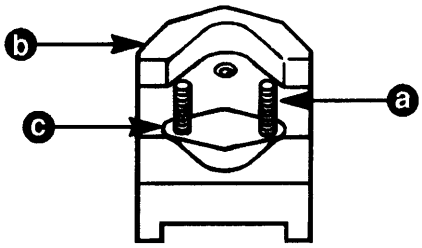
6. Be sure new gasket is in proper position between anodic block and hydraulic manifold. Apply Quicksilver Perfect Seal (P/N 92-34227-1) to threads of screw once they are through block.



70772

EARLIER MODEL ANODE

a - Screws (2)
b - Anodic Block
c - Gasket

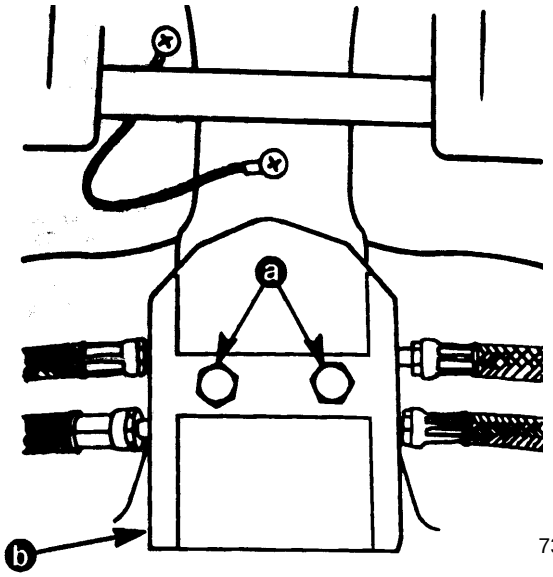


73893

LATER MODEL ANODE

a - Screws (2)
b - Anodic Block
c - Gasket

7. Snug both screws evenly into hydraulic manifold, then torque 80-120 lb. in. (9-14 N·m).



73892

a - Screws And Washers
b - Anodic Block

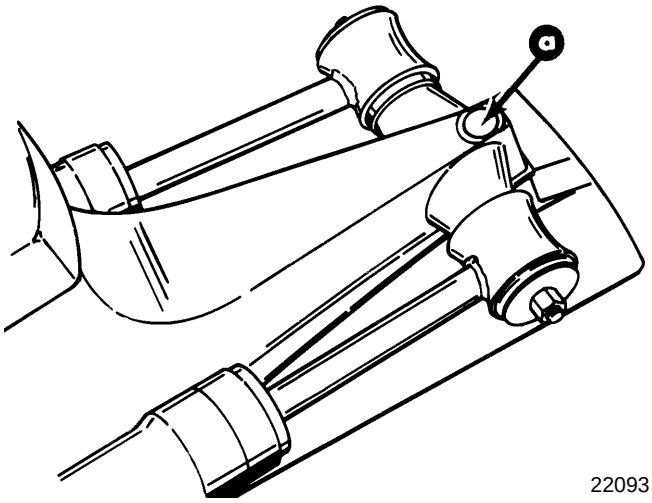
Anodic Trim Tab

Replacement

⚠CAUTION

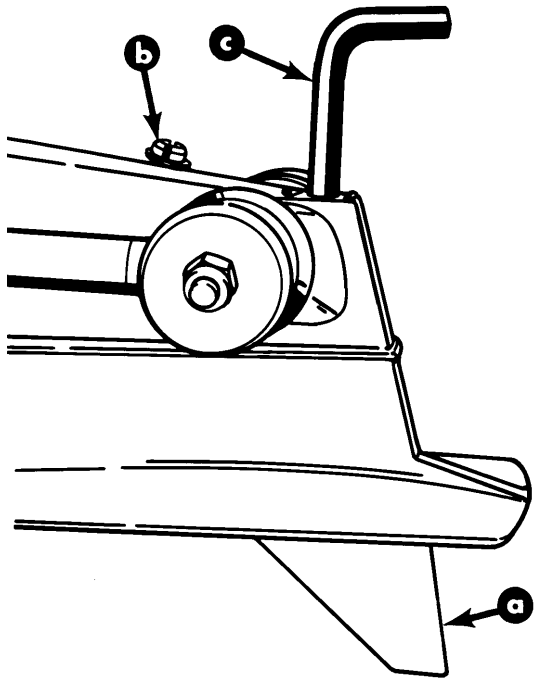
DO NOT paint new trim tab, as this will render it ineffective as a galvanic corrosion inhibitor.

1. Remove plug from drive shaft housing to gain access to trim tab attaching screws.



a - Plug

2. Use an allen wrench and loosen screw and remove trim tab.

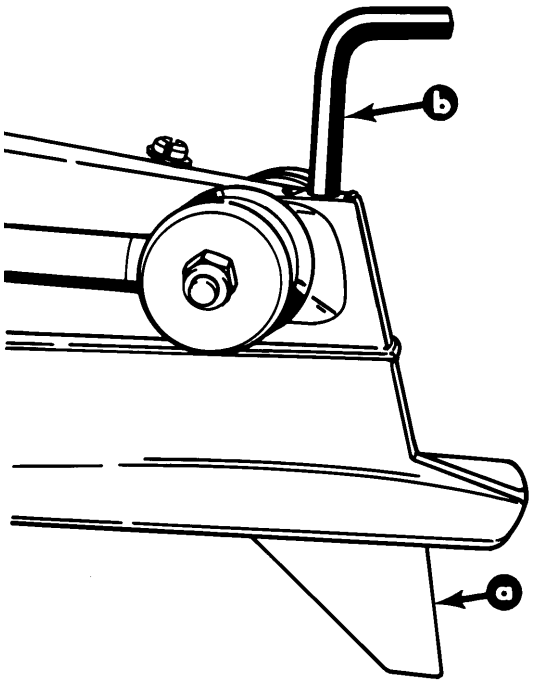


a - Trim Tab
b - Plug-(Removed)
c - Allen Wrench

⚠CAUTION

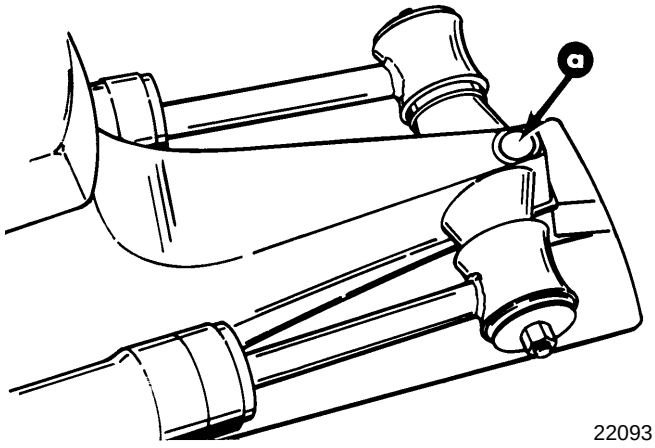
To be effective, new trim tab MUST make good electrical contact with gear housing.

3. Scrape trim tab mounting surface on gear housing down to bare metal.
4. Install trim tab and align straight back. Torque screw to 25-35 lb. ft. (34-47 N·m).



a - Trim Tab
b - Allen Wrench

5. Reinstall plug in drive shaft housing.

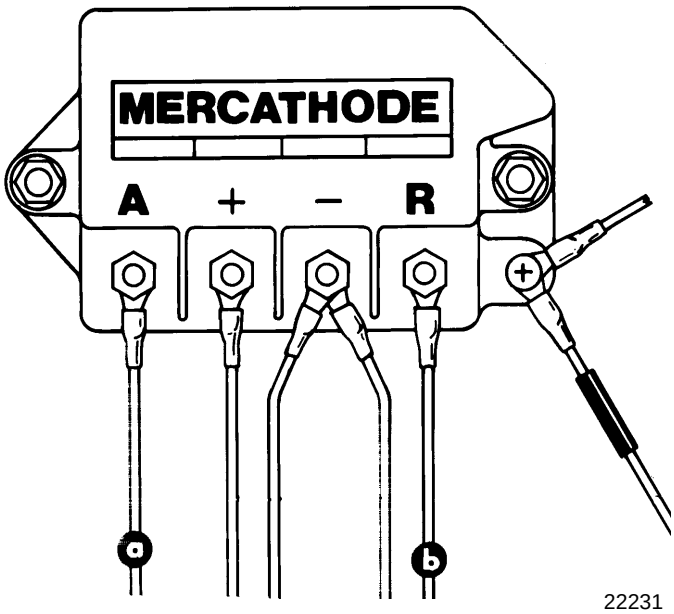


a - Plug

Integral MerCathode System

Removing Electrode Assembly

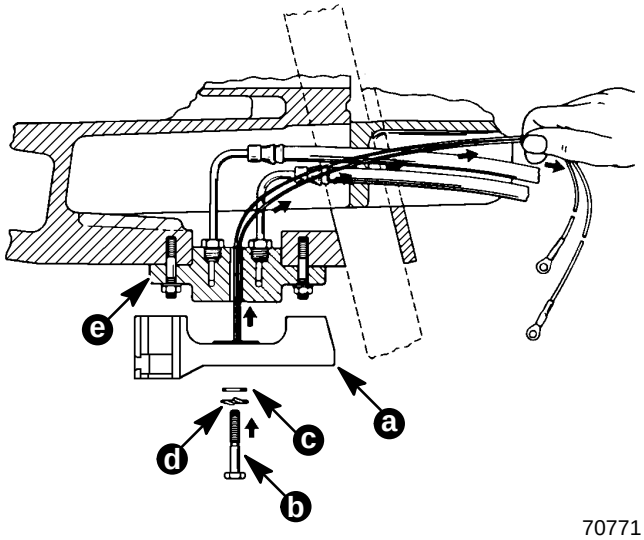
1. Disconnect electrode assembly wires from MerCathode Controller.



22231

a - Electrode Assembly Wire (Orange)
b - Electrode Assembly Wire (Brown)

2. Remove two screws, flat washers and lock washers; then remove electrode assembly.



70771

a - Electrode Assembly
b - Screw (2)
c - Flat Washer (2)
d - Lock Washer (2)
e - Hydraulic Connector Block

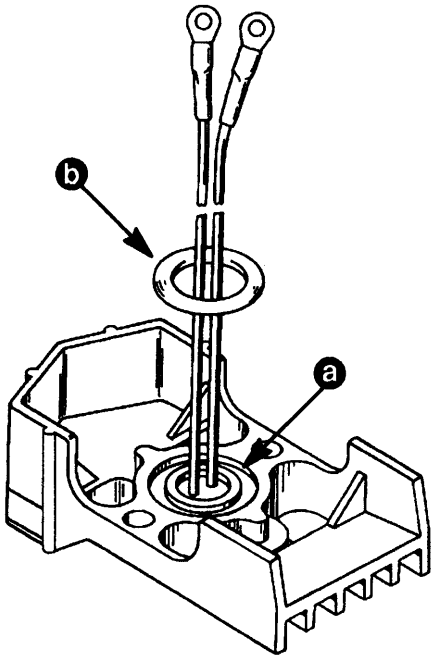
Installing Electrode Assembly

⚠CAUTION

Prevent water from leaking into the boat by ensuring that the O-ring is properly seated in the groove of earlier model electrodes.

IMPORTANT: Replacement electrodes no longer use an O-ring.

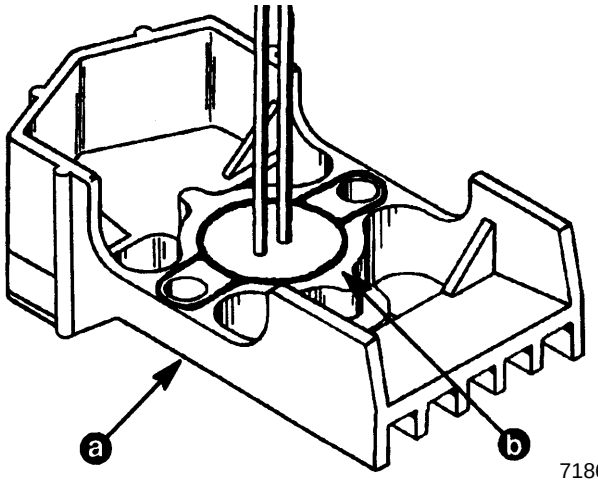
1. **Earlier Model Electrodes:** Install the O-ring over the orange and brown wires from the electrode assembly. Seat the O-ring in the groove. DO NOT use any type of sealer on the O-ring.



70756

a - O-ring Groove
b - O-ring

EARLIER MODEL ELECTRODE

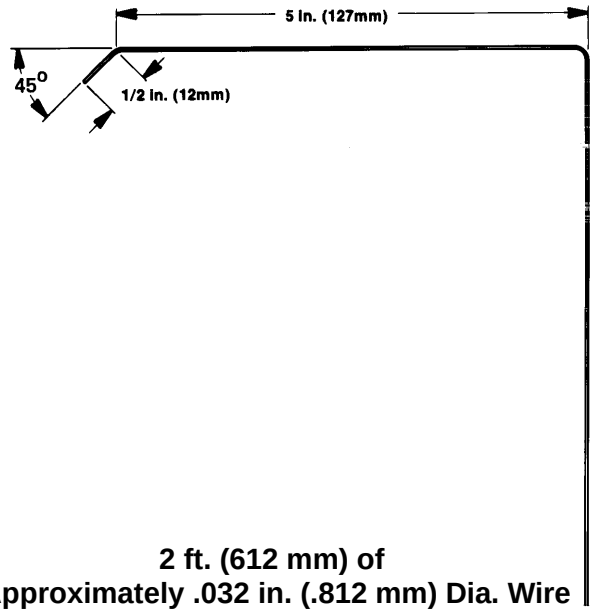


71862

a - Electrode
b - Rubber Grommet

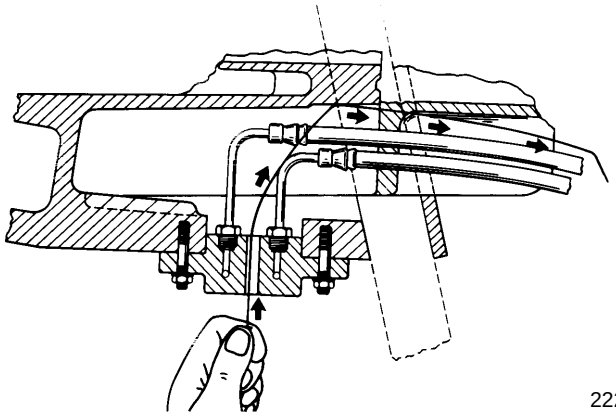
LATER MODEL ELECTRODE

2. Form a 2 ft. (610 mm) long piece of approximately .032 in. (.812 mm) diameter wire to the dimensions shown.



2 ft. (612 mm) of Approximately .032 in. (.812 mm) Dia. Wire

3. Insert 45° angle end of wire through center hole in hydraulic connector block.
4. Guide wire through hole until wire protrudes through cavity on the bottom of exhaust pipe.



22235

5. Secure ring terminals to tracer wire.
6. Guide leads through center hole in connector block.

IMPORTANT: Orange lead is approximately 6 in. (152 mm) longer than the brown lead.

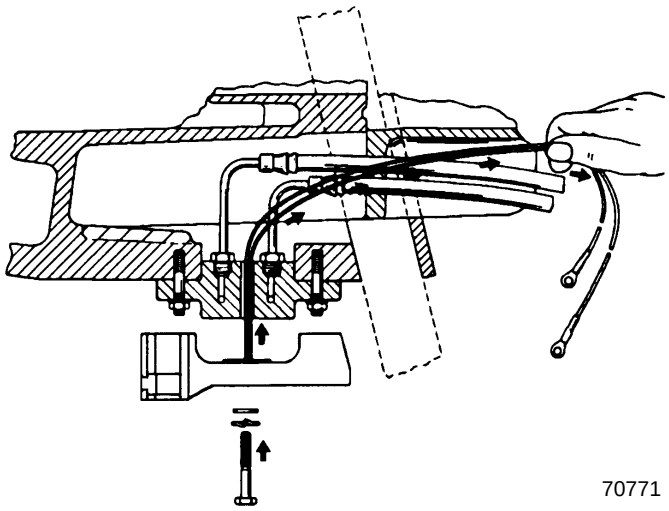
7. Pull leads ALL the way into the boat.

22234

⚠CAUTION

DO NOT paint sacrificial zinc anodes or MerCathode System electrode assembly, as this will render them ineffective as galvanic corrosion inhibitors.

8. Position and secure electrode assembly to gimbal housing using two 1-3/8" (35 mm) long screws, flat washers and lockwashers. Torque to 20-30 lb. in. (2.2-3.3 N·m). DO NOT OVERTIGHTEN.



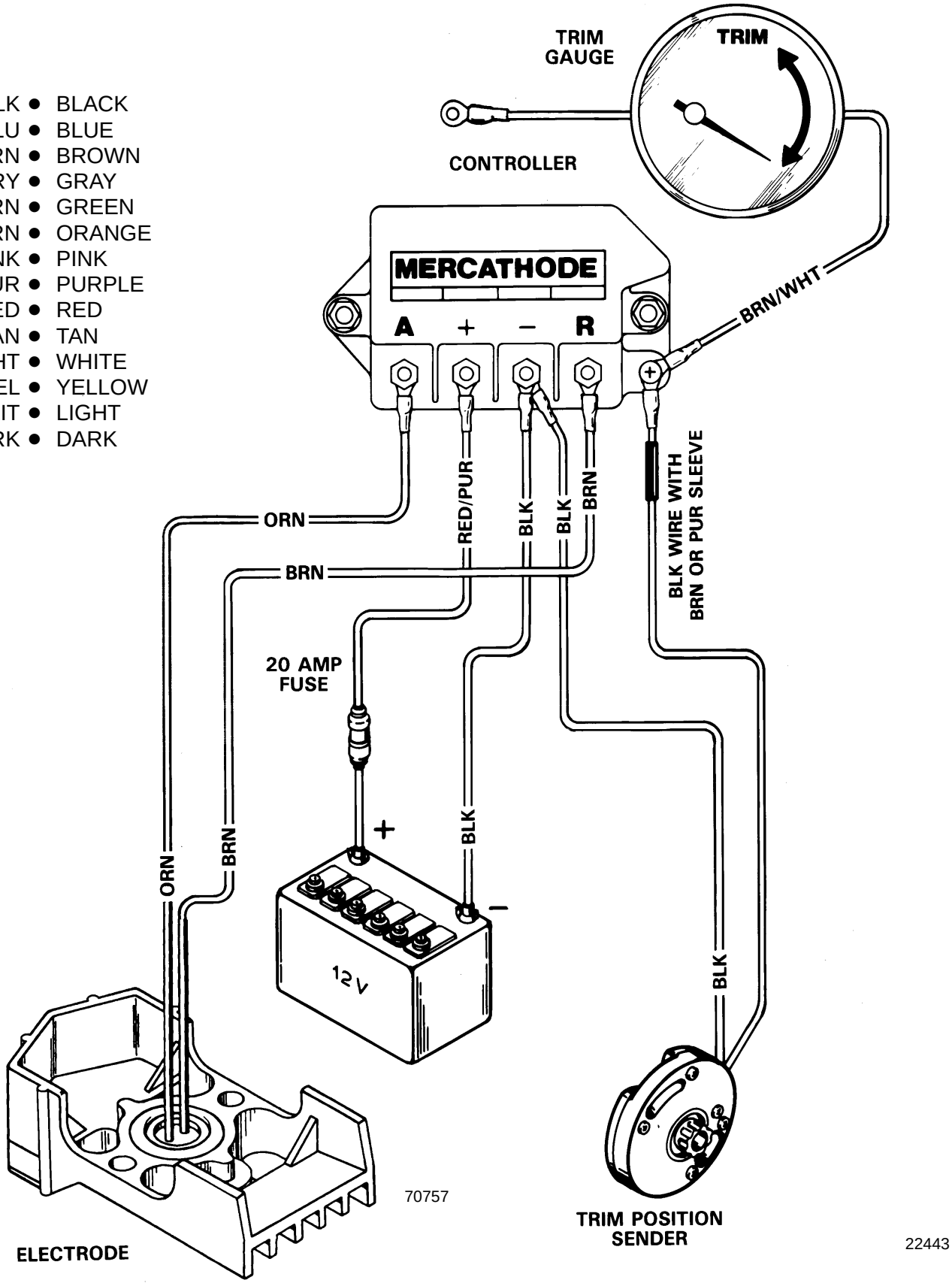
70771

Connect Electrical Leads to Controller Assembly

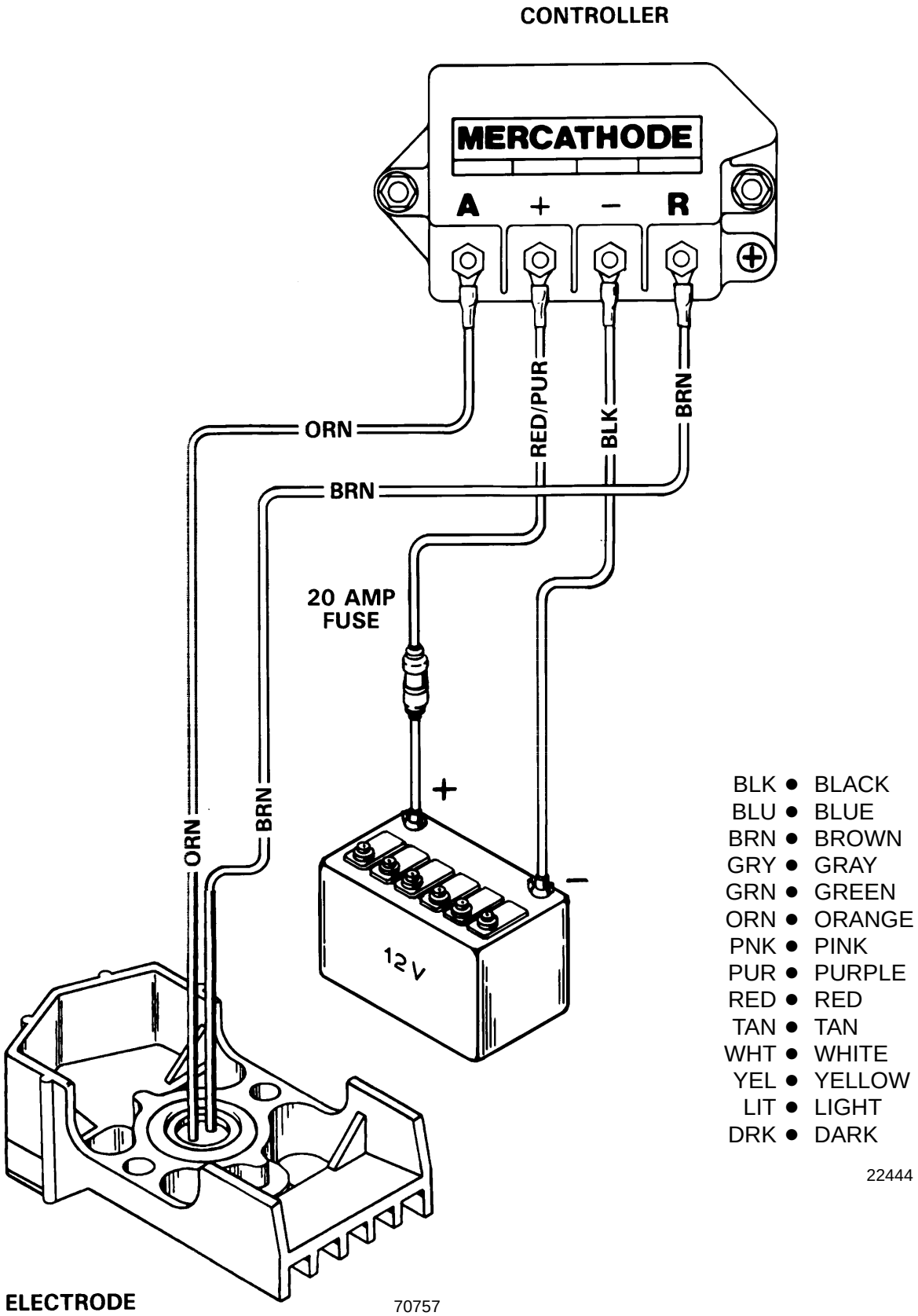
NOTE: *If black (ground) wire is not available at terminal block or from wire harness, install a separate lead between controller negative (–) terminal and negative (–) battery cable attaching point on engine.*

1. Connect electrical leads to controller assembly. (See Wiring Diagrams following).
2. Apply a thin coat of Quicksilver Liquid Neoprene (92-25711) to ALL electrical connections.

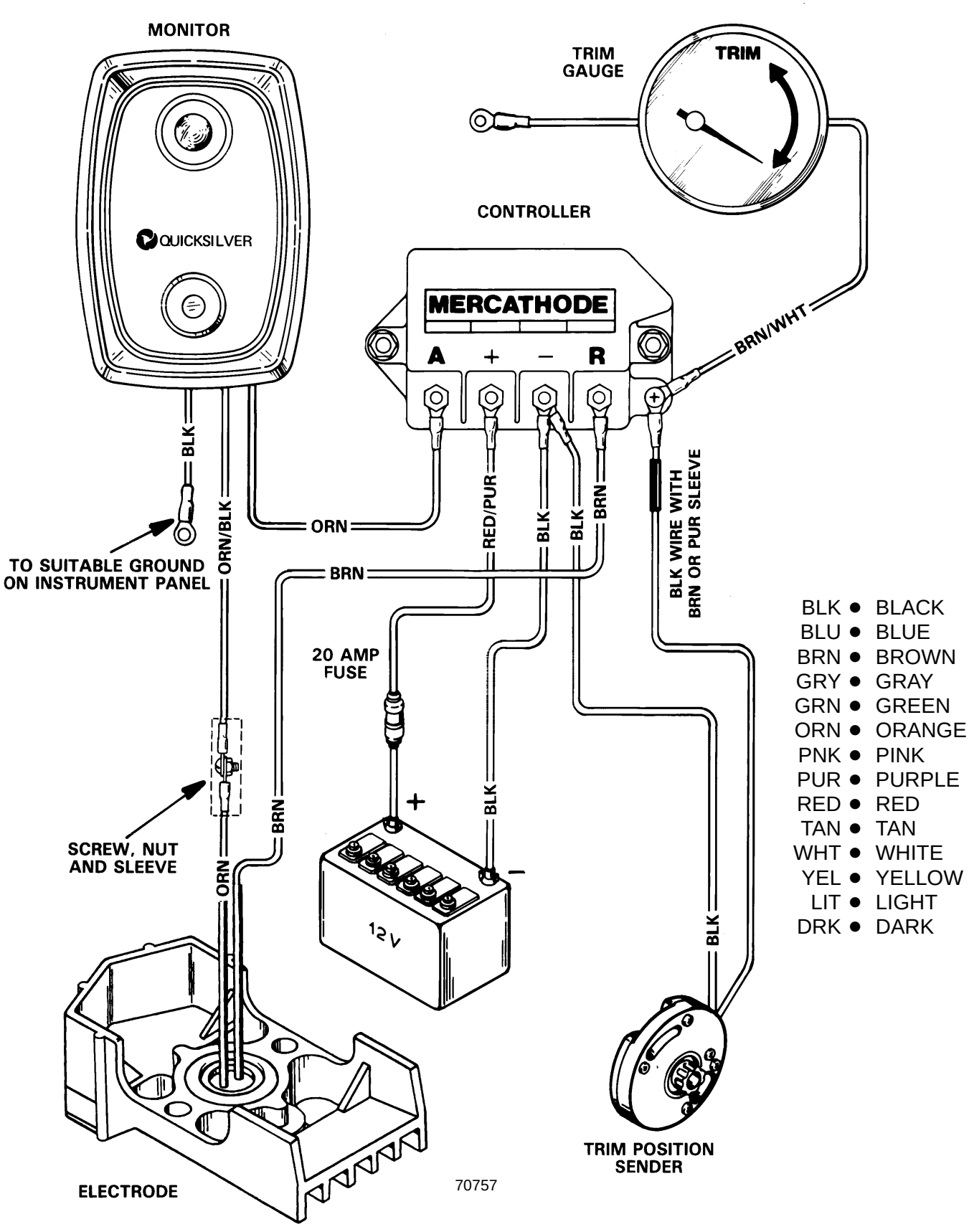
BLK ● BLACK
BLU ● BLUE
BRN ● BROWN
GRY ● GRAY
GRN ● GREEN
ORN ● ORANGE
PNK ● PINK
PUR ● PURPLE
RED ● RED
TAN ● TAN
WHT ● WHITE
YEL ● YELLOW
LIT ● LIGHT
DRK ● DARK



NOTE: *MerCruiser now offers an electrode (98869A8) that does not seal with an O-ring. See the earlier and later model electrodes on page 7A-6.*



NOTE: *MerCruiser now offers an electrode (98869A8) that does not seal with an O-ring. See the earlier and later model electrodes on page 7A-6.*



BLK ● BLACK
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YEL ● YELLOW
LIT ● LIGHT
DRK ● DARK

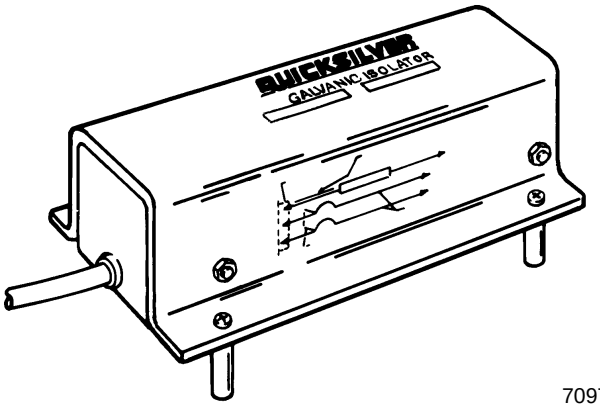
NOTE: *MerCruiser now offers an electrode (98869A8) that does not seal with an O-ring. See the earlier and later model electrodes on page 7A-6.*

Quicksilver Isolator

Boats, which are connected to A.C. shore power, require additional protection, to prevent destructive low voltage galvanic currents from passing through the shore power ground wire. A Quicksilver Galvanic Isolator can be installed to block the passage of these currents, while still providing a path to ground for dangerous fault (shock) currents.

⚠ CAUTION

If A.C. shore power is not isolated from boat ground, the MerCathode System and sacrificial anodes may be unable to handle the increased galvanic corrosion potential.



70972

Corrosion Protection Testing and Troubleshooting

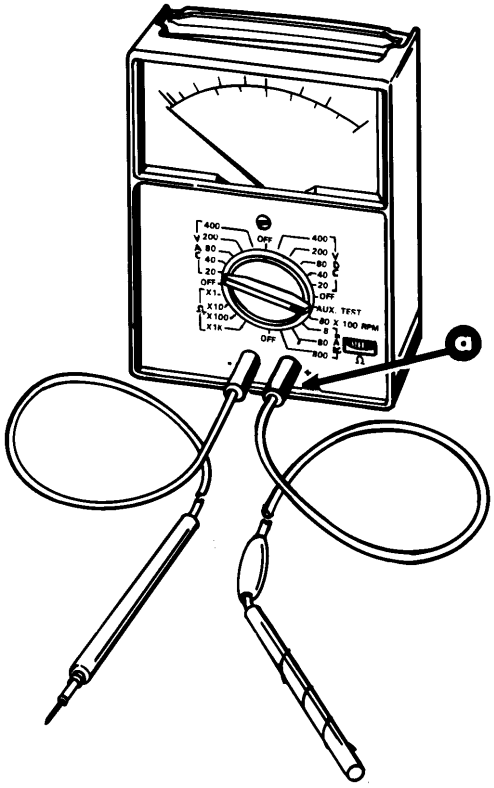
NOTE: *The following corrosion protection test supersedes all previously issued tests. This test can be used on applications with or without a MerCathode System.*

Use the following test to determine if drive unit is being afforded adequate corrosion protection, or if additional corrosion protection is required. If the unit is equipped with a MerCathode System, it is recommended that this test be performed at least once each year (where the boat is moored) to ensure that the system is functioning properly.

Test requires the use of MerCathode Reference Electrode Test 76675A1 and Quicksilver VOA meter 91-62562A1. This meter is no longer available from Mercury Marine. If you do not already have this meter, a digital multi-meter (such as a Radio Shack 22-191) must be used. A STANDARD ANALOG (Needle-Type) METER CANNOT BE USED AS AN INACCURATE READING WILL RESULT.

IMPORTANT: Quicksilver Volt/Ohm Meter 91-93572 and Multi-Meter DVA/Tester 91-99750 are no longer recommended for testing corrosion protection.

The MerCathode Reference Electrode Tester 76675A1 is equipped with a special jack (containing a resistor) to provide the proper scale reading when used with Quicksilver VOA Meter 91-6256A1. Previously, we stated that this plug could be removed to allow tester to be used with other analog type meters. Further testing has revealed that this could result in inaccurate readings and; therefore, **we no longer recommend the removal of this plug and the use of other analog meters.** Resistor jack can be left in place when using digital meters.



22465

Quicksilver VOA Meter 91-62562A1 and MerCathode Reference Electrode Tester 76675A1

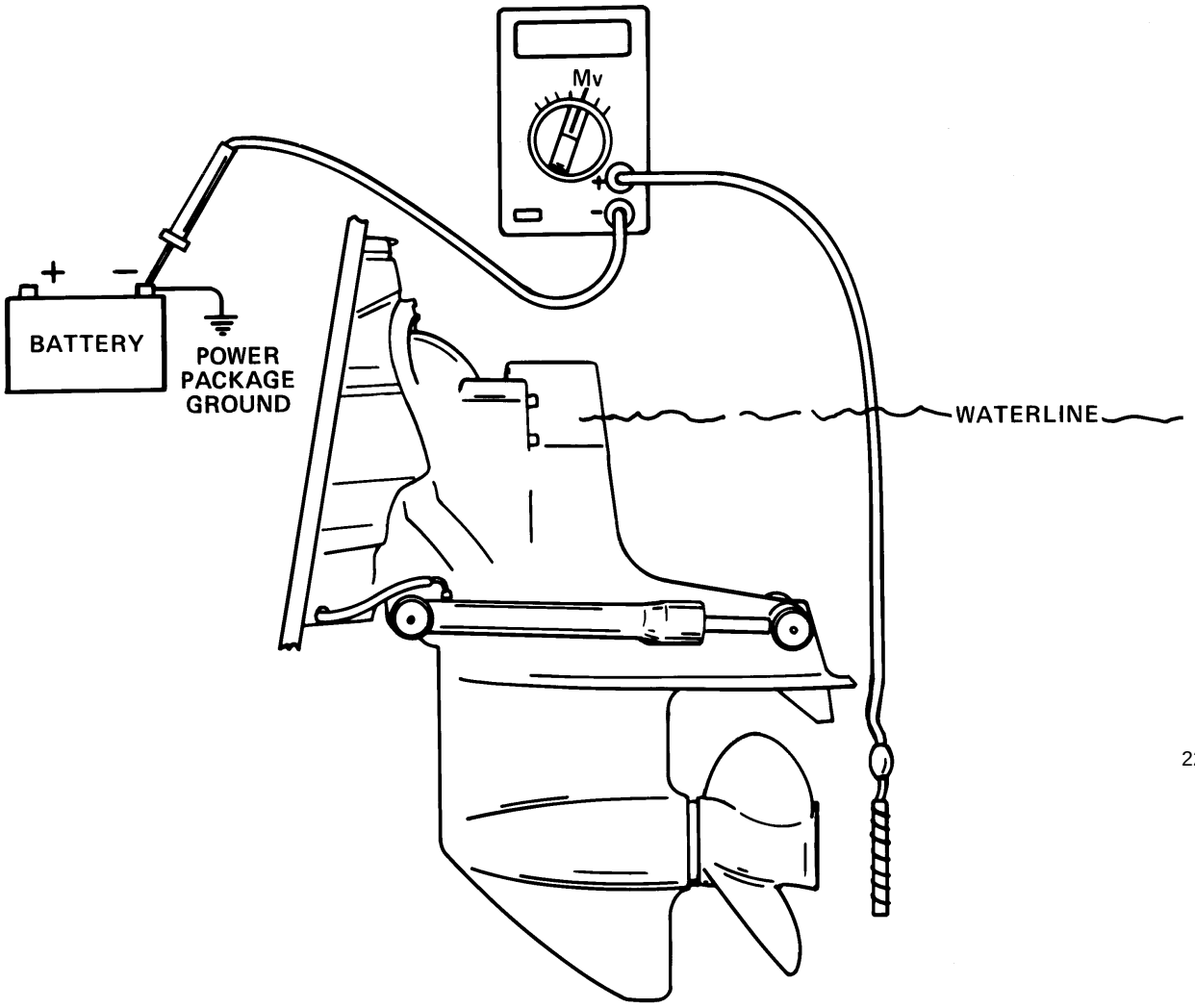
a - Special Resistor Jack

IMPORTANT: Be sure to observe the following when performing test:

- **If unit is equipped with a MerCathode System, make sure that battery is fully charged (12.6 volts or above).**

- **New boats just placed in service usually will produce a reading higher than normal. This is due to the drive unit being protected by a good finish and new sacrificial anodes. To obtain an accurate diagnosis, the test should be performed after the boat has been in service at least one or two weeks. This will give the paint a chance to "soak" and minor abrasions and scratches will have appeared, which will result in a more accurate reading.**
- **Boats should be moored (without being operated) for at least 2 hours before performing tests. This is necessary to allow the MerCathode System and/or sacrificial anodes to polarize the surrounding water. Be careful not to rock the boat excessively while boarding to perform test as this will alter the test reading.**

1. Plug negative meter lead into negative (–) receptacle of meter. Connect other end of lead to negative (–) battery terminal or other convenient engine ground.
2. Plug Reference Electrode Tester lead into positive (+) receptacle of meter.
3. If using Quicksilver VOA Meter 91-62562A1, set meter on "AUX TEST" position. If using a digital meter, set meter on scale required to read 0-200 millivolts (0-2 volts).
4. Immerse Electrode Tester in the water within 6 in. (152 mm) of aft end of the drive unit.
5. The following readings indicate that sterndrive is adequately protected:
   Fresh Water Areas –
   7.5-11.6 with Quicksilver VOA Meter
   750-1160 Millivolts with Digital Meter
   Salt, Polluted or Mineral Laden Water Areas-
   8.8-11.6 with Quicksilver VOA Meter
   880-1160 Millivolts with Digital Meter
6. If the reading is not within specified limits, or if reading is within specifications, but there is evidence of corrosion on sterndrive, refer to the appropriate troubleshooting chart, following to aid in diagnosis and correcting the problem.



22253

Low Reading

Possible Cause	Remedy
1. Loss of continuity between drive unit components and negative (–) battery terminal.	1. Check that continuity devices are not missing or damaged and that connections are clean and tight. If unit is equipped with continuity circuit, test circuit as explained under Sterndrive Continuity Test, preceding.
2. BOATS EQUIPPED WITH SHORE POWER ONLY: Shore power green safety grounding lead not isolated from power package ground.	2. Disconnect shore power and notice if reading increases. If so, a Quicksilver Isolator 76664A1, or an isolation transformer, should be installed.
3. Underwater metal parts on drive unit and/or boat unpainted or paint is in poor condition. More exposed metal than anodes and/or MerCathode System can protect.	3. Prime and paint underwater metal parts. This will reduce the load on the anodes and/or MerCathode System.
4. Anodes painted. Anodes will not provide protection if painted.	4. Remove paint or replace anodes.
5. Anodes improperly grounded or inactive.	5. Clean anode mounting surface or replace anodes if they have oxidized.
6. Anodes consumed (no longer affording protection).	6. Replace anodes if eroded 50% or more.
7. Drive unit and/or boat bottom painted with anti-fouling paint containing copper or mercury.	7. Only Tri-Butyl-Tin-Adipate (TBTA) base anti-fouling paint should be used. (Refer to Anti-Fouling Paint, preceding.)
8. *MerCathode reference electrode or anode painted.	8. Remove paint.
9. Anode heads used instead of carriage bolts.	9. Install carriage bolts.
10. *No power to MerCathode controller.	10. Connect positive (+) lead of volt meter (set on 0-20 volt scale) to “+” terminal on controller and negative (–) volt meter lead to “–” terminal. Meter should indicate battery voltage. Check for blown fuse (if so equipped) on Standard MerCathode System. Clean connection or repair wiring as required.
11. *Poor connection between reference electrode (brown) lead or anode (orange) lead and MerCathode controller.	11. Clean and/or tighten connection. Repair wiring as required.
12. *Faulty MerCathode reference electrode.	12. Disconnect reference electrode (brown) lead from controller “R” terminal. Connect lead to positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect negative (–) meter lead to negative (–) battery terminal. Note meter reading; then repeat test using MerCathode Reference Electrode Tester 76675A1. The same reading should be obtained in both cases. If not, replace reference electrode.

*Applicable to units with a MerCathode System only.

Possible Cause	Remedy
13. *Faulty MerCathode Controller.	13. With anode and reference electrode leads connected to controller, connect a jumper wire between “R” and “–” terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to “A” terminal on controller. Connect negative (–) meter lead to negative “–” controller terminal. Reading should be as follows: • Fresh Water Areas-11.5 volts minimum • Seawater Areas-3.55 volts minimum If reading is low, replace controller.
14. Additional corrosion protection required. Boats which are equipped with a sizable amount of underwater metal (stainless steel prop, after planes, etc.), or that are moored in an area with warm or rapid flowing water, may require additional protection.	14. Additional corrosion protection required. Boats which are equipped with a sizable amount of underwater metal (stainless steel prop, after planes, etc.), or that are moored in an area with warm or rapid flowing water, may require additional protection.

NOTE: **Applicable to units with a MerCathode System only.*

High Reading

Possible Cause	Remedy
1. Stray current corrosion. If an electrical current flowing along a metal conductor leaves the metal for a water path, it will cause ionization of the metal and an area of rapid corrosion.	1. Observe reading while disconnecting electrical components (one at a time) until high reading is eliminated. Correct source of stray current.
2. *Poor connection between MerCathode reference electrode (brown) lead and “R” terminal on controller.	2. Clean and/or tighten connection. Repair wiring as required.
3. *Faulty MerCathode reference electrode.	3. Disconnect reference electrode (brown) lead from “R” terminal on controller. Connect lead to positive (+) terminal of digital multi-meter (set on 0-2000 millivolt scale). Connect negative (–) meter lead to negative (–) battery terminal. Note meter reading. Repeat test using MerCathode Reference Electrode Tester (76675A1). The same reading should be obtained in both cases. If not, replace reference electrode.
4. *Faulty MerCathode controller.	4. Replace controller.

*Applicable to units with a MerCathode System only.

Normal Reading But Corrosion Is Evident

Problem	Possible Cause	Remedy
Corrosion on Entire Drive Drive Unit	Drive unit raised so far that sacrificial trim tab is out of the water.	Drive unit must be left “In” (“Down”) position when boat is moored for trim tab to provide protection.
Corrosion Problem Developed after Drive Unit was Refinished	Steel wire brush used to clean aluminum casting. Steel particles become entrapped and set up a small galvanic cell.	Use a nylon or bristle brush only.
Paint Blistering on Drive Unit	Battery charger, which uses 110 volt shore power, improperly connected to battery.	Make sure charger is connected correctly.
Trim Cylinder Corroding	Loss of continuity between trim cylinders and drive unit.	Install proper continuity devices.
Corrosion isolated to one or two components (bell housing, gimbal ring, etc.)	Loss of continuity between drive unit components.	Test circuit as outlined under Sterndrive Continuity Test, preceding.
Corrosion in Area of Exhaust Outlets	Accumulation of exhaust gas deposits on the drive exterior may result in paint blistering and corrosion.	Deposits can be removed with marine or automotive wax which also will help protect finish.
Corrosion Occurs After Unit is Removed From the Water	Salt crystals remain on the surface of drive components and high humidity causes electrolyte to form with subsequent corrosion resulting.	Wash exterior and flush interior with fresh water.
Corrosion Between Surfaces	Salt buildup between surfaces.	Exclude moisture from between mating parts with Quicksilver Special Lubricant 101, 2-4-C Marine Lubricant or Perfect Seal.
Aluminum Corroding in Areas Where Lubricant Was Applied.	Lubricant used contained graphite.	Never use lubricants which contain graphite as they will accelerate corrosion.
Stainless Steel Components Corroding	Foreign matter (fish line, marine growth, etc.) covering steel and starving it of oxygen. This causes a breakdown of the protective oxide film and subsequent corrosion (known as oxygen starvation corrosion. Burying stainless steel in sand or silt also can cause this problem.	Remove foreign matter and prevent surfaces from being covered by sand and silt.
Stainless Steel Propeller Corroding	Loss of continuity between propeller and prop shaft.	Clean mating surfaces on propeller, propeller shaft and attaching parts. If applicable, install continuity washer. Torque propeller nut to 55 lbs. ft. (75 N·m).
Paint blistering-Metal under blistered paint is not pitted	Surface was not properly prepared before paint was applied.	Sand surface down to bare metal, prime and repaint with Quicksilver Spray Paint.